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An Account [of the Measurement of two Base Lines in Florida, Section VI, *United States Coast Survey.* By FAIRMAN ROGERS, Civ. Eng. The information from the Archives of the Coast Survey, communicated by authority from the Treasury Department.

The great importance of extreme accuracy in the measurement of a base line, for any extended geodetic operations calls for an apparatus, which shall overcome the three following difficulties:

First: The difficulty of determining the exact length of the measuring apparatus with reference to any fixed unit, or to a quarter of the earth's circumference, to which all geodetic distances must be referred.

Second: The avoidance of error from change of length in the apparatus, with variations of temperature and moisture. And,

Third: The very nice manipulation required in the field, to make the contacts or coincidences so perfect that there shall be no chances of error in the practical measurement; a view being had at the same time, to economy of time and labor in the use of the apparatus.

In the operations of the United States Coast Survey, the French metre has been adopted as the unit, its length being more accurately determined than that of any other standard. Its value, as compared with the American standard, is 39·36850154 inches. The metre being at 32° Fah., and the inches at 62° Fah. In the outset, this comparison of the metre with the foot, is a matter of great difficulty, owing to the want of coincidence of the several English and American standards.

The difficulty of making a bar of metal so nearly equal in length to another bar as to differ by a quantity inappreciable in a single length, is not very great; but when this discrepancy, however small, comes to be multiplied by one or two thousand, the number of bars in a base line, the error becomes very sensible, it being, unlike most instrument errors, a cumulative one.

The method adopted for making this comparison of length will be described farther on.

The second difficulty, that of keeping the apparatus at a given length in spite of the changes of position, temperature, and moisture, or of making a perfect correction for these changes, has always been a great one.

Various means have been tried. Steel chains very carefully made, are found to be very unsatisfactory in practice, owing to the difficulty of keeping them uniformly stretched, of supporting them throughout their entire length, and of determining and applying the correction for temperature.

Glass rods have been tried, giving no better results.

Deal or other wooden rods are rather less accurate than either, as they are very readily affected by the varying moisture, and will warp and twist in all directions.

As an illustration of these changes, I give the following comparison of the different lengths of the same base measured on Hounslow Heath, English Ordnance Survey:

With deal rods,	. . .	27405·7607 feet.
" glass rods,	. . .	27403·38 "
" steel chain,	. . .	27402·38 "

The difference between the measurement with deal rods and the steel chain being 3·3807 feet in a base of about five miles.

To obviate this difficulty, arising from change of length with the temperature, the principle of compensation already used in the pendulum, was introduced by Captain Colby, in the apparatus for the measurement of the Lough Foyle Base in 1827. Two bars, one of iron and one of brass, fastened together in the middle and free to move at the ends, carry at each end a "lever of compensation," so proportioned to the expansion of the two metals, that while they move relatively to each other, a fine platinum point on the lever maintains an invariable distance from the centre of the apparatus, and consequently, from the point on the lever at the other end. That is, the distance between the two platinum points is invariable and independent of the change of temperature. Using two sets of these bars in the measurement, the points on each are brought within the proper distance of each other by means of two microscopes mounted on a compensating bar of a few inches in length.

This apparatus gave moderately good results, but was not very convenient in use, owing to the difficulty of setting the microscopes in making the coincidence with sufficient rapidity.

A compensating apparatus on the same general principle, was constructed by Simeon Borden, Esq., Civ. Eng., of Massachusetts, and used by him in the survey of that State in 1830.

The "rules" of Borda made for the survey of France, were constructed on rather a different principle. The rule or bar itself was of platinum, the

expansion of which metal by heat had been determined with much care, and close alongside of it, and attached firmly at one end, was a bar of copper, the coincident edges of the bars at the free end, being divided in arbitrary divisions read by a vernier on one bar; this constituted in fact a metallic thermometer, and the changes of temperature of the platinum were read on the scale, and the proper correction for temperature thus determined.

In none of these arrangements, had any attention been paid to the different specific heats of the composing metals. In Captain Colby's apparatus, the absorbing qualities of the rods were partially equalized by the coatings of varnish upon their surfaces, but their cross sections were exactly the same.

In the years 1845, 1846, Professor Bache having taken charge of the operations of the survey of the coast of the United States as Superintendent, determined by a long series of very careful experiments, the relative cross sections of the bars of iron and brass, which were to constitute a new base apparatus for the use of the survey, depending upon their differences of specific heat and conducting power, the absorbent qualities of their surfaces being adjusted by the use of different colored varnishes.

The apparatus as it now exists was arranged by the Superintendent, and made in the Coast Survey office, under the direction of Mr. William Würdemann at that time mechanician of the survey. It consists primarily of two bars, one of iron, the other of brass, about nineteen feet long, firmly fastened together by means of a piece at one end, and perfectly free to move past each other longitudinally in expanding or contracting, being hung on rollers in stirrups from the iron truss frame which stiffens the whole apparatus. The skeleton diagram here given will serve to show the relations of the several parts.

In this diagram the relative proportions of the parts are not preserved, it being much distorted in order to show the arrangement more clearly.

D B is the iron bar, D C the brass bar, firmly united at D; at C, the lever of compensation, A C is jointed to the brass bar, and its polished steel surface at B, is kept pressed against the end of the iron bar D B, by the spring represented near A, which is so attached to the small rod A G, which has a slot in the middle wherein the end A of the lever works, that it constantly acts to draw the rod back, and the end of the lever along with it. The arms of the lever A B and A C are proportioned to each other as the expansion of iron to brass. A B : A C : : 1100 : 1748, or very nearly, as the expansions given by Smeaton of iron ·00125800, and by Laplace of brass ·00186671.

So by reference to the diagram it will be seen, that when the iron bar expands by heat from B to B′, the brass bar will have expanded from C to C′, and the arms of the lever being properly proportioned to these expansions, the point A of the lever will not be moved, but will keep

exactly its normal distance from D. The expansion of the iron rod G, is allowed for in the arrangement, and it carries upon its end G, a polished agate plane rather less than a quarter of an inch in diameter, which is the surface of contact at that end of the apparatus.

We now come to the third difficulty mentioned, that of making the contact or coincidence of the ends of the bars, so that it shall be accurate, safe, and convenient, for the method of operation must be by placing one in the line to be measured with one end directly over the starting point, and then bringing the second in the line, and accurately coinciding with the end of the first, either by actual contact, or by being kept at an invariable distance by means of reading microscopes.

Microscopes as used by Captain Colby and by Mr. Hassler on the old coast survey apparatus, are inconvenient and difficult to adjust with speed and accuracy, and in devising the present apparatus, Professor Bache applied the contact level of Bessel, which had been hitherto used for the purpose of observing comparisons of length. The action of this level is shown in the diagram.

F H is a small iron rod similar to A G, but carrying an agate knife edge, with its edge horizontal, instead of a plane. E is a small delicate level moving on a centre, represented by the small black dot between E and H, and supported from the bars. From the lower side of the level a short arm projects, against which the end of the rod F H abuts; the inside end of the level is weighted, so that it naturally assumes an inclined position and pushes the rod F H out, any undue motion being prevented by stops. The distance between the two agates is therefore always a little more than the standard length, six metres, and it is so adjusted that when the rod is pushed in, moving the level in the manner of a bell crank, the bubble stands in the middle when the agates are just the proper distance apart; in short, the position of the bubble in the centre of its run indicates the accurate adjustment of the length. In reality the contact level is not fastened directly to the bars themselves, but to the bar of a very delicate sector level, the centre of motion of which is exactly in the axis of the agates, and which is kept always level, so that the inclination of the bars, which is sometimes unavoidable on uneven ground, does not affect the position of the contact level. This sector level serves also to show the inclination of the bars from the horizontal plane, in order to apply the correction for versed sine.

These constitute the essential parts of the apparatus. The bars are suspended in stirrups from a plate iron truss frame, which keeps them steady, and the whole is enclosed in a double tin tube with an air space between the two parts to prevent sudden changes of temperature being communicated to the bars, with glass doors in the middle and at the two ends, for the purpose of reading the enclosed thermometers and observing the contact. From the fact of these tubes being the visible part of the apparatus, each piece of apparatus is technically called in Coast Survey parlance "a tube," a base being said, for instance, to consist of so many tubes, meaning so many times six metres.

To each *tube* at a distance of about five feet from each end, is lashed underneath it and transversely, a bar or *handspike*, by which the tube is carried, four men acting as *bearers*. Close to this handspike, and at the

rear end of the tube, are a pair of trunnions running transversely, which fit into corresponding horns on the rear trestles, and at the forward end a plate with two holes which fit on two projecting pins on the top of the fore trestles. The trestles are tripods of iron, the legs resting on foot screws, and capable of elongation by a telescopic arrangement worked by a rack and pinion, and a vertical main screw which raises the head, which has the two motions of a slide rest in the horizontal plane, the transverse motions of both trestles, and the line motion of the rear trestle being governed by screws, precisely like those of a slide rest, and terminating in square shanks to which the handles may be fastened. Each trestle carries a small circular level for adjustment. Eight trestles are required. Ten cast iron plates made to receive the foot screws of the trestles, a wooden frame for placing the foot plates in the proper position, and a wooden bar with a sector level upon it for setting the trestles at the proper distance and level to receive the tubes, complete the equipment.

Upon first arriving on the ground, the comparisons of the tubes with the standard iron six metre bar, are made for the purpose of insuring that no change has taken place during their transportation.

For this purpose two stone or hard wood pillars are sunk in the ground, at a distance of six metres apart and properly protected from the effects of surrounding vibrations by wooden boxes around them in the ground.

Fixing the points of the compass for convenience, at a distance of twenty feet north from the east pillar, another pillar is sunk, the tops of all being on the same level, and about the height of a trestle from the ground. Two trestles on their foot plates are placed in the proper positions in the line between the pillars, and the tube placed upon them. On the top of the west pillar is a brass plate with a vertical part, through which passes the *abutting screw*, a steel screw with a square end made perfectly perpendicular to the axis of the screw, and adjusted so as to be in a vertical plane.

The agate knife edge abuts against this screw. On the top of the other pillar is fixed a plate carrying a vertical standard supporting a small mirror, which turns upon a vertical axis through a small arc, an arm projecting from the back of the mirror carrying a fine screw with a rounded end, which rests against the agate plane of the east end of the tube, a spring keeping it always against the plane.

On the third, or north pillar, which is at right angles to the line of the tube, and opposite the east pillar, is a small theodolite telescope with a vertical hair, so placed that a graduated paper scale placed directly underneath it, can be seen through the telescope reflected in the mirror. All being arranged, the standard iron bar supported in its box is put in the "*comparator*," levelled by the trestle screws, and the end made to abut against the screw on the west pillar; the *mirror screw* resting against the agate plane, a certain part of the scale is reflected in the mirror, and read through the telescope, by its coincidence with the vertical hair; this reading is noted, as is also the temperature of the bar at the ends and the middle as indicated by the attached thermometers; the bar is then taken out and one of the tubes substituted; this is moved in a longitudinal direction, until the contact level is brought exactly right by the pressure of the knife edge against the agate plane, and the reading of the scale as

reflected into the telescope again taken; the difference of reading gives the difference of length between the *tube* and the *standard*. The bar is then again put in, and this is repeated a great many times with each tube, the exact length of which compared with the standard reduced to a constant temperature being thus determined. There are sixty of these scale divisions to 11·68 inches on the scale, so that the actual length of each division is very nearly one-fifth of an inch, and therefore very easily read. Owing to the difference of length between the arm on the back of the mirror, and the distance between the mirror and the scale, one scale division corresponds to a change of length in the bar or tube of ·000157 of an inch, giving the means of ascertaining with great delicacy the minute changes in length in the bar.

This arrangement of mirror and scale, is known as Saxton's pyrometer, and has been before used in magnetic observations.

The comparisons are usually continued for two or three days, and the results afterwards reduced in the office. These being finished, the actual measurement is begun, the end of the base has already been marked in some permanent manner, and the line has been carefully ranged out as in running a tangent on railroad work.

A good transit is set up on a continuation of the line run forty or fifty feet back, and adjusted to bear upon the signal at the other end of the base or upon the proper range marks. Stubs have already been driven at distances of about 200 metres along the line and the centres accurately marked.

The tubes are ranged in line with the transit, by means of two sight vanes which they carry at their forward ends, the plates are laid in the places where the advancing tubes are to come, and the four trestles not in use are placed upon them. A transit instrument is then set up in a line at right angles to the base at its beginning, and about forty feet from it, and the agate knife edge brought carefully over the point in the copper bolt beneath it. The agate plane on the forward end of the first tube is exactly six metres from the copper bolt, the second tube is then drawn back by means of the distance screw of the trestle, until the contact level reads level, when the agate plane of its forward end is exactly twelve metres from the bolt, the number of tubes, the temperature, and the inclination, or the note, level, if there is none, is recorded.

The Superintendent makes the contacts during the whole of the operation. So much being ready, the Superintendent when the contact is perfect says "*made*," "*break*," whereupon the assistant at the rear end of the first tube draws it rapidly back by means of the distance screw.

The trestle screws have long handles with a universal joint which can be stuck on to any screw at pleasure.

The plate represents the measurement at the moment of making contact, the figure at the extreme left being the assistant, holding the distance screw just ready to turn off at the word "*break*." The handle of the main screw for adjusting the level is attached to the trestle and rests on the ground at his feet.

The Superintendent, in a stooping position, is observing the contact level through the small window in the rear end of the second tube, and moving the tube slowly in the line by a fine motion screw with his left

hand to make the contact. The first assistant is seen moving from his place at the forward end of the second tube to the forward end of the first tube, to take charge of its advance, upon hearing the order "*break*," while the assistant is turning off, the four bearers, only two of which are represented in the drawing, advance to their places on each side of the tube. The first assistant having arrived at his place, turns the tube out of the line by means of the azimuth screw in the front trestle until the Superintendent says "*clear;*" the order is then given to the bearers "*raise forward*," "*step out*," "*raise aft*," "*step out*," "*forward*," and the bearers supporting the tube by the handspikes carry it past the other tube to its place in front; the assistant at the rear hastily detaching his two handles and following the tube, holding on to it to guard against accidents from a bearer stumbling.

"*Halt*" is then called; the trunnions of the tube are placed in the horns of the rear trestle, and the tube is slowly swung into its place, the Superintendent watching the agates closely to see that all is clear; when all is right the bearers step aside, the tube is aligned by the observer at the transit; the level adjustments are made by the assistants with their trestle screws; the contact is made roughly by the rear assistant with his distance screw, and he goes back to his old place as represented in the sketch, ready to turn off again at the word "*break*."

In the meantime as soon as two trestles are disengaged by the advance of the tube, four trestle men immediately carry them forward, and place them upon the plates already set for them, as is shown in the drawing, and two plate bearers stepping inside of the plates, which are hollow, lay them in their proper places in the wooden frame which guides them, a man preparing the beds for them with a hoe. An officer with the bar carrying the sector level, sets the trestles at the proper distance and level, for the reception of the tubes, and arranges the adjustment of the trestles to suit the varying nature of the ground. When the tubes cannot be exactly level, the inclination is read and noted, and the correction or the sum of the corrections, which is the sum of the versed sines of the angles of inclination to a radius of six metres, is subtracted from the measured length. The temperature, number of tubes, inclinations, &c., are recorded by an assistant who is shown on this side of the tube.

On leaving the tubes for breakfast and dinner, a stub was driven under each end of the last tube, and an ordinary lady's dressing pin driven into it, exactly under the agate as aligned by a transit instrument, placed at right angles to the line.

At night more permanent marks were made by driving three stubs, one under the end of each tube and one under their intersection, and marking the points projected by the transit upon copper nails driven in them.

The tubes are allowed to remain in their places all night, covered by their india rubber cloths, a guard being left with them in any country where there is danger of their being disturbed.

On commencing operations the next morning, the points are verified by the transit instruments and the measurement continued as before.

At every distance of 268 tubes, or about a mile, granite mile stones are sunk with the point carefully projected upon a copper bolt, and fur-

ther fixed by two stubs in the line and two at right angles to it, the intersection of the lines passing through them marking the point.

At the end of the base, if that end has been already marked and connected with the triangulation, the distance between the point and the end of the last tube is carefully measured with a fine beam compass.

The apparatus is then carried to the comparing tent, and two or three days spent in careful comparisons with the standard, while the other assistants make the marks permanent and set the monuments, marking the ends of the base.

On referring to the map of Florida, it will be seen that the great chain of Florida Keys commences at Key Biscayne, (Fort Dallas,) near the south end of Florida, in latitude 25° 39′, longitude 77° 03′, and sweeps off in quite a regular curve of nearly a quarter of a circle to Key West, in latitude 24° 32′, longitude 81° 47′, extending, in fact, in a few scattered keys to the Dry Tortugas. The main land runs in a southerly direction, to a point opposite Carysfort Reef, and then turns suddenly to the west as far as Cape Sable, which is the extreme southernmost point of the main, leaving Florida Bay and Barne's Sound, quite considerable sheets of water, between the reef and the main.

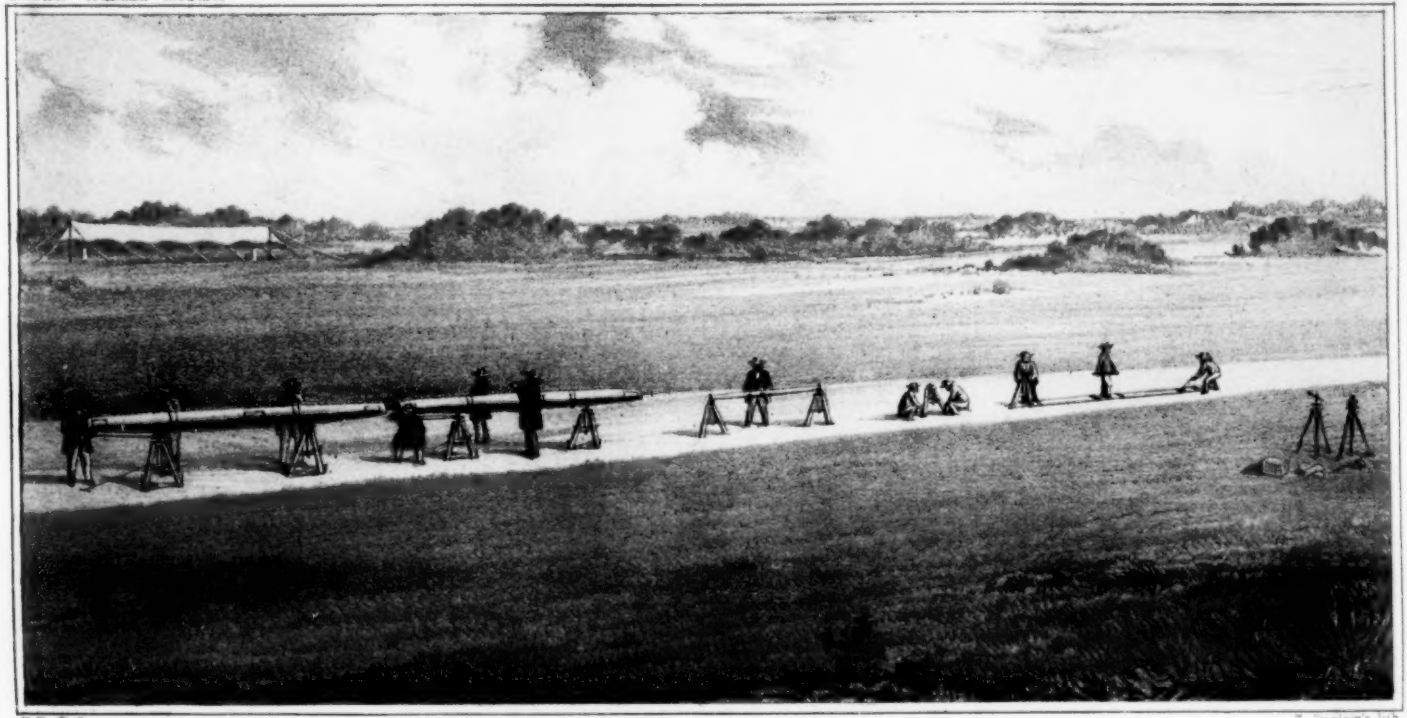
Outside of the range of keys, and about ten miles from them, runs the Florida Reef, which is of coral rock, and extends almost to the surface, the dread of all coasting vessels, which, in order to get into the Bay of Mexico, must enter the narrow passage between Cuba and the reef.

The dangers of this coast have always been considered very great, and the number of shipwrecks is proved by the extensive wrecking business that has always been carried on at Key West.

The determination of the positions of these reefs and keys is, of course, an object of great importance, and is attended with considerable difficulty on account of the entirely uninhabited condition of the Keys, the flatness of the country, and the immense amount of detail requisite for the proper delineation of the Keys. For the purposes of the triangulation sites for two bases were selected, one on Key Biscayne and one on Cape Sable, and that on Key Bescayne measured with iron wires, connected with the triangulation which was based upon it, and the south end occupied as an astronomical station.

Preparations were made for the final measurement of these two bases with the base apparatus in the Spring of 1855, and accordingly, the Superintendent, who always conducts the base measurements himself, with his party arrived at Key Biscayne on the 2d of April, and immediately commenced operations.

The camp had already been pitched on the sea shore near the south end of the base, which ran nearly north and south. The island is entirely uninhabited, except by the light-house keeper and his family, and covered on the north-west side with dense forests of black and red mangrove, and on the south-east with a thick growth of the scrub fan palmetto, with here and there a sea grape tree and a few bushes. A fine sandy beach, not of great width, extends along the eastern side, on which the base, on which the secondary triangulation of the Keys rests, had previously been measured with iron wires.



F. R. Del. F. Sinclair's lith.

MEASUREMENT OF A BASE U. S. COAST SURVEY.

Moment of Making Contact.

The line had been grubbed and graded throughout nearly its whole length of three and a half miles, and both ends marked in the usual manner by copper bolts let into heavy stone monuments sunk to the level of the ground and capped with a small stone pyramid, so that they could be again found.

South Base had been previously occupied as an astronomical station, and its latitude, longitude, and azimuth determined. The line was also chained and levelled for the profile. It was arranged that the measurement should be commenced at North Base, so that we should work towards camp, and after the comparisons were finished, the tubes, trestles, &c., were taken there in a flat towed by the schooner.

The actual measurement was now begun. At four o'clock in the morning, the summons to turn out was given, and by half past four all the party were on the way to North Base, a distance of about four miles from camp. Arrived there, the tubes which had been placed in the line the day before, were uncovered, and the transit set up in the continuation of the line, as mentioned, the position of the first tube over the initial point adjusted by the transit across the line, the levels of the sectors tested with an engineer's level, and the measurement commenced as before generally described. The work was continued until eight o'clock; from eight to nine was devoted to breakfast on the line; the work then resumed until one; dinner on the line from one until half past two, and operations resumed until about five, making about eight hours a day of actual work. The work of the first day or two lay through black mangrove woods and swampy ground, and the mosquitoes and sand flies tried the patience of the observers sorely; the trees, too, cut off the sea breeze, and, although in the shade, the thermometer stood at an average of 84°·5 F. At night the tubes were covered up, the trestles dressed in their triangular canvass covers, and left without any guard, as there were no inhabitants to disturb them and no signs of any Indians.

After leaving the woods and coming out upon the open plain, which was covered with scrub palmetto about four feet in height, through which the path was cut, the heat was, at times, very oppressive even when tempered by the sea breeze. Nine days were employed in the measurement, half a day being lost on account of rain, and half a day from an accident to the apparatus, which, however, was repaired without much delay. The end of tube 965, reached beyond the marked point of South Base, and being projected on a stub in the ground, the distance 0·34775 metres was measured back with a beam compass.

The last tube was set in the afternoon just in time to finish and get the tubes into camp before dark.

In camp the comparisons were resumed and resulted very satisfactorily, the sandy ground being extremely firm and the posts consequently stable. An improvement was made in the scale by lengthening it so as to bring on the whole range of the changes instead of part of the range, being read from the terms of the mirror screw, as was the case before.

The whole apparatus was then packed up and despatched in the schooner Bowditch to Cape Sable by the Duck Key passage.

The Superintendent proceeded to Cape Sable by way of Key West, coasting along the reef and inspecting the triangulation and topography.

At Saddle Hills near Key West word was brought him from Cape Sable that the condition of the prairie at that place, would make the measurement impossible, for the ground, which is but little above the level of the sea, was only a pasty mass of mud, owing to the heavy rains. Such information was very discouraging, but preparations were made for immediate departure for the scene of difficulty, and after a delay of a short time at Key West owing to a continuous north-east gale, the schooner swung at anchor a few hundred feet from Fort Poinsett, a mythical kind of establishment on the point of Cape Sable, consisting of an embankment forming two sides of a triangle and capable of holding about a hundred men.

Here things were found to be in rather better condition than was anticipated, the rain had ceased, and the ground had attained a sufficient solidity, for the purposes of the measurement.

The absence of the camp, which was to have been pitched, was satisfactorily accounted for by the tales of the musquitoes, which were described as exceeding anything of the kind in any other part of the world.

A party, consisting of an officer and several men, which had been left on shore with a camp for two days and nights, were taken off in a state of absolute exhaustion from want of rest, having spent all night in combats with these fearful insects.

The whole party had therefore to content themselves with their rather restricted quarters on the schooners, which were anchored about a mile out in the bay to avoid these flying marauders, which would have troubled us at a shorter distance from land.

As it was uncertain how long the fine weather would last, it was determined to commence immediately with the measurement and to postpone the comparisons until the end, and very fortunately, as the event showed, as, when the levels were run over the line after the measurement, the ground had already become somwhat soft from rain, and the last day on shore was memorable for a drenching rain, which fell much to the annoyance of the parties who were finishing the operations.

Cape Sable Prairie, as far as it has been explored, is a strip of five or six miles in width, between the sea and the everglades, bounded on the west by the sea, and extending an indefinite distance towards the east, a doubtful sheet of water called White Water Bay, the position of which is rather a matter of uncertainty, being to the north of part of it and the everglades completing the northern boundary. It is an exceedingly beautiful place, apparently made for the site of a base line, as smooth and level as a floor, and carpeted with a great variety of plants and grasses, some of which change their colors with the different stages of growth and give beautifully varied hues to the ground.

Mangrove hammocks of varied shapes and sizes spot the prairie at intervals, the appearance of which is pretty well shown in the accompanying sketch. These hammocks are filled with a variety of orchids or air plants which grow in great abundance on the trees, the cactus, whose short stinging pines interfere much with the passage through them, and the Spanish bayonet, whose magnificent white spike of flowers frequently shows out against the dark mangrove. But this beautiful place is cursed with musquitoes, so that we found it impossible to begin work on shore

until nine o'clock, A. M., and necessary to stop by five in the afternoon; after this time clouds of them issued from the woods, and assailing any individual who was unfortunate enough to be on shore, drove him to the boats in a state of impotent rage.

The measurement here was briskly carried on, the level nature of the ground making the operation very rapid, the average time of one tube being 2 minutes 51 seconds against 4 minutes 20 seconds at Key Biscayne, and many of the tubes were made in less than two minutes. An average of 2 minutes 51 seconds would make about one-tenth of a mile an hour, but in some of the hours, as much as one-eighth of a mile was done, showing a rapidity of measurement hitherto unapproached in any of the base measurements with other forms of delicate apparatus. Eight days were occupied in the measurement of this base, which is 1072 tubes or 6432 metres in length, a trifle short of four miles. The ends of the base and the first and third miles were marked by iron screw piles sunk level with the ground, and filled with concrete, a copper bolt being fixed in the centre on which the point was marked, two smaller piles in the line and two across it, marked still further by the intersection of the lines through their centres the ends of the base. The second mile being the centre of the line and on firm ground was marked by a granite monument.

The annexed table gives the comparison of the measurements of the bases at Dauphine Island, Bodie's Island, and Edisto, with the Florida Bases.

	Dauphine Island.	Bodie's Island.	Edisto Island.	Key Biscayne.	Cape Sable.
Whole number of tubes measured,	1777	1807	1787	965	1702
" " " days employed, .	17	10	13	9	8
" " " hours " .	143 h. 17 m.	81 h. 08 m.	97 h. 28 m.	66 h. 31 m.	46 h. 26 m.
" " " tubes level, . . .	961	1496	862	473	994
" " " " inclined, .	816	311	925	492	78
Average length of working day, . .	8 h. 25 m. 7 s.	8h. 07 m.	7 h. 30 m.	7 h. 23 m.	5 h 48 m.
" " " time of one tube,	5 m. 32 s.	2 m. 54 s.	3 m. 22 s.	4 m. 20 s.	2 m. 51 s.
" number of tubes per day, .	104·5	180·7	137·5	107·2	134
" " " " " " of 9 hours, ...	108·0	197·9	165·9	130·0	200
Average number of tubes per day of 9 hours.	11·85	21·98	18·4	14·4	22·47
Temperature of attached thermo'r,	84° 5 F.	52°·0	· 59°·5	82°·9	87°·9
Average tubes per hour of greatest day's work, ...	18·4	30·7	22·3	17·7	29·9
Greatest day's work, miles, . . .	0·70 mile.	1·06 mile.	0·75 mile.	0·63 mile.	0·73 mile.
Date, ...	May, 1847.	Nov., 1848.	Jany., 1850.	April, 1855.	May, 1855.

Neither of the bases were measured more than once, partial re-measurements on other lines having shown the probable error to be so exceedingly small as not to be important, it being noted as about one-tenth of an inch for the entire base.

Six officers, including the Superintendent, and about sixteen men are required for the operations in the field, besides those in the camp or on the vessels, cooks, &c. In the sketch a number are omitted to prevent confusion, and the officer at the transit aligning the tubes is too far along the line to be visible.

The Cape Sable Prairie is well stocked with deer, numbers of which were seen every day, and a sufficient number shot to keep the party in venison for some time.

The Indians, if there were any in the neighborhood, kept carefully away, perhaps deeming the party too strong for them, although they must have been attracted by the clouds of smoke which rolled up from the prairie which we had set on fire for the purpose of clearing it.

The long walls of flame as seen at night from the vessels, added very much to the beauty of the scene.

One large black bear, which fell a victim to the men who pursued it into the water and despatched it with boat hooks and oars, a few coons, some wild cats, and forty-three alligators, which a reconnoitering party saw holding a caucus in a creek, were all the wild animals that we met with.

On the 17th and 18th of May, all the operations being finished, the party left Cape Sable on their way to the north, everything having been accomplished without any accidents or serious sickness, although all the men were from the north and unused to out-door work in such a warm climate.

The triangulation based upon the original Key Biscayne base, measured with wires, has been carried on down the reef, and that base having been connected with the new one, the small correction necessary for the sides of the triangles can be applied, it being too small to affect the topographical work.

It may not be amiss in concluding this article to give the references to articles on the measurement of bases and the different forms of apparatus that have been devised for that purpose.

L. B. Francœur, Traité de Géodésie, p. 129, and Notes sur le Mesure des Bases, in the same volume. Frome, Outline of Trigonometrical Survey, p. 5. Aide Memoire to the Military Sciences, London, Art. Surveying. Lieutenant Hunt's Description of Apparatus and Plate of Details, U. S. Coast Survey, Report for 1854, p. 103. Hackley's Trigonometry, p. 316. Everest on Arc of Meridian in India, 4to., p. 50. Captain Yolland, Lough Foyle Base. Palfrey's Tables, Survey of Massachusetts. Trans. Am. Phil. Soc., Vol. ix, p. 34. N. Am. Rev., Oct., 1845, p. 458. Coast Survey Reports, 1847, p. 39; 1848, p. 43; 1849, p. 38; 1850, p. 34. Recueil des Observations Géodesiques, par Biot et Arago. Base du Systeme Métrique Decimal. Puissant, Geodesie, p. 203. Davies' and Peck's Dictionary of Mathematics, pp. 61, 272.

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*Sounding Rapid Currents.**

To the Editors of the Philosophical Magazine and Journal.

Gentlemen,—Seeing an account, which is making the tour of the newspapers, of an attempt to sound the depths of Niagara, which failed in consequence of the great velocity of the stream not allowing the plumb to sink, it struck me that that which could not be accomplished by main force, might be done by a very simple contrivance.

The principle on which a schoolboy's common kite mounts in the air, overcoming the law of gravity, is well known; and I should think that an apparatus constructed on the same principle, and perhaps of a like

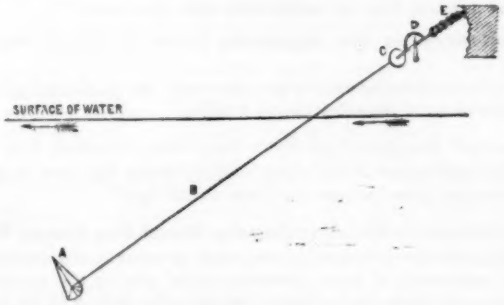
* From the Lond., Edin. and Dub. Philos. Mag., August, 1855.

form but much smaller, and strongly made of iron, would by the action of the current of water be forced to the bottom of the river. All boys know that the stronger the breeze, the higher the kite flies. The depth might be easily determined by the angle of the detaining chain or wire, with the surface of the water. I merely throw out the hint, hoping it may perhaps lead to the invention of some apparatus that will overcome the difficulty.

I enclose a rough diagram, and remain, sirs,

Your obedient servant,

W. SOWERBY.



A. Kite, strongly made of thick sheet iron,

B. Detaining chain or wire.

C. Reel fixed at the end of bar carrying the scale D, with a pointing needle weighted to keep perpendicular.

E. Chain and hook to attach the apparatus to the shore or bridge.

AMERICAN PATENTS.

List of American Patents which issued from October 23d, to November 13th, 1855, (inclusive,) with Exemplifications.

OCTOBER 23.

84. For an *Improved Dovetailing Machine;* John Bell, Harlem, New York.

Claim.—"The combination of the box clamp or frame, or its equivalent, for holding the pieces to be dovetailed or tenoned with the series of rotating cutters. Also, in combination with the double inclined tables, the double set of rotating cutters having the planes of the edges of the cutters working parallel with said tables."

85. For an *Improvement in Scythe Fastening;* Cyrus Clapp, Montague, Mass.

Claim.—"The fastening of scythes to snathes by means of the concave socket and section of a ball to which the scythe is attached, and the centre bolt."

86. For an *Improvement in Felting Hat Bodies;* William W. Cumberland, Newark, New Jersey.

Claim.—"1st, The arrangement and combination of the hollow cone and solid cone placed within it, the larger ends of said cones being uppermost, having a wedging space between them of a proper size and angle, whereby the hat body, placed between them in the wedging space, will tend to tighten itself by its own weight in the space, as it is rolled between the cones. 2d, The combination and arrangement of the yielding roller frames with the table, one of them having such a motion around the shaft as to croze or

change the position of the hat body by the friction of the rollers upon the hat body upon one side, and the friction of the hat body on the table on the other side. 3d, The combination of the weights, the roller frames, levers, and the pivots attached to the cone, for the purpose of lifting the weight of the cone, and thus diminishing the friction of it upon the collar of the shaft on which it rests below. 4th, Partially felting hat bodies, enclosed in their more tender state, in a hollow elastic cone of vulcanized india rubber, or other suitable material, lined with cloth, the larger and uppermost, in which the hat body is placed in an open conical form, corresponding to that of the cone by means of a process of bending or crimping, produced by the revolution of the elastic cone between two surfaces at a less distance from each other than the diameter of the cone, but not so near to each other as to cause the sides of the hat body within it to rub against each other, or the hat body to form itself into a roll."

87. For an *Improvement in Coal Lifters;* John B. Creemer, Philadelphia, Pa.

Claim.—"The dish and feet, in combination with the screen."

88. For an *Improvement in Gas Regulators;* Julius C. Dickey, Saratoga Springs, New York.

Claim.—"The valve chamber cast in one piece with the perforated plate, in combination with the adjustment of the valve placed outside."

89. For an *Improved Daguerreotype Plate Vise;* Samuel S. Day, City of New York.

Claim.—"The combination of the clamp with the screw rod, bow, and cam piece, to hold the daguerreotype plate between and beneath the lips."

90. For an *Improvement in Finishing Carpets;* Samuel Fay, Lowell, Mass.

Claim.—"Giving to woven figured fabrics, such as carpets, the finished appearance derived from the application of heavy pressure, whilst placing the goods in a roll for convenience of transportation, and without distorting the pattern by an irregular undue stretching of the fabric."

91. For a *Card Printing Press;* Thomas Harsha, West Union, Ohio.

Claim.—"Attaching the box which contains the form to the lever, and connecting said lever with the ink rollers and feed rollers, so that when the lever is moved and the form brought over the ink bed, the paper will be fed over the bed on which the paper is printed, and when the lever is moved over the bed, in order to print the paper or cards, the charged ink rollers will pass over the ink bed, whereby the ink bed is kept properly charged with ink, and the paper fed over the bed on which the paper is printed, and the paper or cards printed by simply moving or operating the lever. Also, passing the paper between two knives arranged in relation with the lever, so that the printed paper or cards will be cut off in proper lengths, as the form is pressed upon the paper, the knives cutting off a previous impression at each depression of the lever."

92. For an *Improvement in Melodeons;* George G. Hunt, Wolcottville, Conn.

Claim.—"The construction, whereby two, four, or more sets of reeds may be operated by one and the same valve."

93. For an *Improvement in Safety Apparatus in front of Railroad Cars;* Charles Mahon, Washington, D. C.

Claim.—"The peculiar and novel combination and arrangement of the vertical and horizontal rollers with the bar."

94. For an *Improvement in Seed Planters;* Daniel B. Neal, Mount Gilead, Ohio.

Claim.—"The arrangement of the shovel, the slotted and grooved slide, and gauge slide."

95. For an *Improvement in Sealing Preserve Cans;* Stimmel Lutz, Philadelphia, Pa.

Claim.—"Sealing of a double sided can or jar at the outside, at or near the bottom."

96. For an *Improvement in Preparing Cotton Seed for Extracting Oil;* Oscar Reisenbach, Norriton Township, Pennsylvania.

Claim.—"The application of sulphuric acid or acids in general, to free cotton seed as it comes from the cotton gin, from all surrounding cotton fibre, previous to the extraction of oil from the seed."

97. For an *Improved Machine for Sweeping Gutters, &c.;* Robert A. Smith, Philadelphia, Pennsylvania.

Claim.—"1st, An adjustable gutter brush, made to conform to or correspond with the shape of the gutter to be swept, so constructed and arranged, that it may be removed from and applied to the end of the shaft which carries it with facility. 2d, The guard or gauge wheel, arranged so as to prevent the gutter brush from being carried too hard against or over the curbstones, so as to derange or injure it. 3d, So arranging the gutter wheel by means of an angular axle, that the lowest portion of the tire, and the lower portion only, will come in contact with the curbstones."

98. For a *Machine for Composing and Setting Types;* William S. Loughborough, Rochester, New York.

Claim.—"1st, The presentation of the type cells in the machine, those of each case in the font forming the arc or segment of a circle. 2d, The means which shall deliver the types from the various cells into the jaws of the transits fixed to a wheel or other rotary motion, for conveying the types from the slides to the galley or composing chamber. 3d, The combination of the lever, head, tappets, and springs, with the line register, and its appurtenances, the lever, rule, or justifier, detent, and the index, and index plate, whereby the operator is enabled, simply, by touching the keys, to do the entire business of composing types, and without a transfer of each line separately."

99. For an *Improvement in Elastic Diaphragm Steam Pressure Regulators;* Joseph Woodruff, Rahway, New Jersey.

Claim.—"The chains as arranged in relation to the cupped edge or convex surface of the piston, for controlling and guiding the piston and keeping it in its central position, without coming in contact with any substance to cause friction when operated upon by the diaphragm."

100. For an *Improvement in Whipple-Trees;* George H. Yard, Trenton, N. J.

Claim.—"The traversing slide provided with a point fitted to the pole in the hook, in combination with a sliding pin to fasten it when the end of the slide is put into the hook to fasten the end of the trace on to the hook."

OCTOBER 30.

101. For an *Improvement in Rice Hulling Machines;* Robert Anderson, Brooklyn, New York, and John E. Anderson, City of New York.

Claim.—"The adjustable segmental concave faced with india rubber, in combination with the spiral springs, and a ratchet faced hulling cylinder."

102. For a *Machine for Manufacturing Corks;* William R. Crocker, Norwich, Conn.

Claim.—"The application of the revolving cylindrical cutters to cut corks from a block or slab, whether the cutters are slit or cut tapering or conical, or unslit, to cut cylindrical corks. This mode of construction, use, and application, allowing myself the privilege of varying the same in detail, while the principal and distinguishing characteristics are retained."

103. For an *Improved Device for Gauging and Setting Saw Mill Dogs;* Luther B. Fisher, Coldwater, Michigan.

Claim.—"The spring bar, in combination with the ratchet rim and lever stud."

104. For an *Improved Method of Hanging Mulley Saws;* Isaac N. Forrester, Centreville, Virginia.

Claim.—"The manner or mode of hanging saw blades by forming thereon, or attaching to the front edge only of one or both ends, devices, which I term saws or guide flanches, and the working or applying the same in grooves or guide places, whereby the back edge and principal part of the saw blade is free and unstrained and without any rigidity or stiffness, other than that of the blade itself."

105. For an *Improvement in Cooking Ranges and Air Heaters;* Julius Fink, Philadelphia, Pennsylvania.

Claim.—"The arrangement of the dust bar and exit flue leading from the passages surrounding the oven, within the air heating chamber. Also, in combination with a

hot air chamber, which is heated by conduction, and independent of the heated or burning gases which pass around the oven, the carrying of said gases back and up through a flue located in said hot air chamber, for the purpose of re-heating the gases and causing them to ascend more rapidly by their rarification."

106. For an *Improvement in Straw Cutters;* Luther B. Fisher, Coldwater, Mich.

Claim.—"Ear, in combination with angular groove pieces, and rock shaft."

107. For an *Improvement in Machinery for Braiding;* Liveras Hull, Charlestown, Massachusetts.

Claim.—"Arranging and applying a rotary spring, pulley, and a tripping stud, or its equivalent, and tubular guide journal, with respect to the bobbin and its spring pawl, and so as to operate therewith."

108. For an *Improvement in Nut Machines;* Robert Griffiths, City of Alleghany, Pa.

Claim.—"The tables with the boxes and punchers, whether connected together or not."

109. For an *Improvement in Surface Condensers for Steam Engines;* Peter Hogg, City of New York.

Claim.—"The arrangement of two or more coils or worms of pipes within a surrounding vessel, when the several coils are in succession coiled of a smaller diameter and placed one within the other and each separately attached at top and bottom. Also, causing the condensing water, which enters the surrounding vessel, to travel around in the said vessel."

110. For an *Improvement in Locks;* Richard G. Holmes and William H. Butler, City of New York.

Claim.—"1st, Arranging the spindle or arbor of the lock in such a relation with the bolt, that the bolt may be operated by drawing and pressing the spindle or arbor in a direction transversely with the casing of the lock. 2d, The cylindrical bolt; also, connecting said bolt to the spindle or arbor by means of the lever. 3d, The employment or use of the sector tumblers when attached to a sliding plate and used in connexion with a spring, which is acted upon by the bended or inclined projection at the side of the bar or casing, for the purpose of preventing the lock being picked by obtaining a knowledge of the position of the slots in the tumblers, by pressing the tumblers singly against the plate."

111. For an *Improvement in Lamps;* John Stuber and Thomas Hardin, Utica, N. Y.

Claim.—"The use of tube connecting the drip-cup with the reservoir. Also, the arrangement of tube, in combination with the rod."

112. For an *Improvement in Looms;* James O. Leach, Ballston, New York.

Claim.—"1st, The combination and arrangement of the shifting lever, connecting rod, and eccentric, operated by the gearing, or their mechanical equivalents, for the purpose of varying the movement of the loom harness or heddles, so as to produce solid or tubular fabric with the same warp, and vary the solid or tubular weaving, so as to produce bags of any desirable capacity. Also, the mechanism for determining and regulating the intervals between the shift of the cams, viz: stops on the shaft of the eccentric, governed by a stop lever, being operated by a horizontal cam, which is itself turned by a ratchet wheel whose pawl is driven by the oscillating motion of the lathe, in combination with the partially toothed level wheel."

113. For an *Improvement in Ventilating Railroad Car;* H. L. B. Lewis, Philadelphia, Pennsylvania.

Claim.—"The peculiar construction and arrangement of the ventilating box or case. Also, a reciprocating curved deflector adapted to be moved only horizontally to right or left for directing currents of air into the car."

114. For an *Improvement in Ring and Traveler Spinning Frames;* Henry Luther, Providence, Rhode Island.

Claim.—"Combining with the twisting mechanism and the delivering rollers, or mechanism of a ring and traveler spinning frame mechanism, a mechanism which, while the cop or bobbin increases in size, shall so increase the rotary movements of the spin-

dles and the delivery rollers, as to maintain uniformity in the twist and strain of the yarn."

115. For an *Improvement in Sewing Machines;* L. W. Langdon, Rochester, N. Y.

Claim.—"1st, Making a stitch by tying a half knot or a whole knot at the will of the operator. 2d, The snail worm on the revolving vertical face plate, for the purpose of holding the thread until the knot is tied and the casting it off in time for the stitch to be drawn up. 3d, The vertical face plate into which the shuttle is set for the purpose of carrying it around, and the re-action of the looper for quickening the motion of the shuttle as it passes the needle, for the purpose of letting the looper pass out freely. 4th, Feeding the material by the needle when combined and arranged with the lateral motion of the needle, that is to say, in connexion with the rock shaft, with the sliding step in the end, the connecting rod of the spring, the set screw and rollers, the cams, the sliding bar, and the adjustable lever."

116. For an *Improvement in Stoves;* William Mootry, City of New York.

Claim.—"The application and employment of iron work, or other regular metallic cellular interstices, in combination with stoves, furnaces, and other heating and cooking apparatus or such heated surfaces generally."

117. For an *Improvement in Lamps for Burning Volatile Liquids;* E. N. Horsford, Cambridge, Massachusetts, and James R. Nichols, Haverhill, Massachusetts.

Claim.—"1st, The combination of the safety wick tube with the safety tube or casing around it. 2d, The combination with the safety tube or casing, the perforated safety chamber with its tube barbed at the top, to contain and hold the wick in place, 3d, Making the wick tube in two parts or divisions, separable or not, so as to form the safety chamber in which the barbed portion of the lower wick tube terminates."

118. For an *Improvement in Corn and Cob Mills;* George Patten, Washington, D. C.

Claim.—"The double surfaced breaker and crusher between the upper portions of shell and burr, in combination with a shell and burr, as specified."

119. For a *Spoke and Axe-Helve Machine;* Owen Redmond, Rochester, New York.

Claim.—"1st, The partially revolving bed constructed, arranged, and operating, so as to submit different pieces of wood to the action of the cutters at its forward and backward movements. 2d, The bed having a laterally swinging spring plate, in combination with the adjustable guide, for submitting curved timber to the action of rotary cutters in direction of its curve. 3d, The curved bed, traversing with an undulating movement, for submitting curved timber to the action of rotary cutters."

120. For a *Method of Ventilating Railroad Cars;* J. K. Taylor, Bridghampton, N. Y.

Claim.—"The vertical slotted tubes placed at the outer side of the windows of the car and having air forced through them."

121. For an *Improvement in Roofing Compositions;* James West, Syracuse, N. Y.

Claim.—"The use of lime, in combination with the rubber, gutta percha, and shellac solutions."

122. For an *Improved Lath Machine;* Aretus A. Wilder, Detroit, Michigan.

Claim.—"As my improvement in re-sawing and bringing plank to an equal width, at the same time, is the flanched brad rollers with their springs, or equivalents, in combination with the adjustable back rest."

123. For a *Machine for Cutting Double Tenons;* C. P. S. Wardwell, Lake Village, New Hampshire.

Claim.—"The combination and arrangement of the intermediate obliquely set or drunken saw, with the clearing or finishing true circular saw for operation together, and whereby the drunken saw not only serves to largely reduce the wood between the tenons, as required, for the completion of the tenons, but to form a wider kerf or pathway for the axle of the finishing saw to admit of the deep insertion of the latter into the wood, and of its operation as a clearer between the double tenons during the continuous progress or feed of the timbers."

124. For an *Improvement in Bedstead Fastenings;* John W. Yothers, Spruce Grove, Pennsylvania.

Claim.—"In connexion with the screw rollers or tenons on the ends of the rails, is the combination of the tubular segmental nuts and the buttons with each other and with the posts, in such a manner, that by turning the said buttons, the rails can be secured with their knobs in any desired position, and by the act of thus securing the rails, the buttons themselves will be drawn so closely against the outer surfaces of the posts, as to make perfectly tight and insect-proof joints between the buttons and the posts."

125. For a *Machine for Feeding Paper to Printing Presses;* Henry W. Dickinson, Assignor to Lansing B. Swan, Rochester, New York.

Claim.—"The general arrangement of the devices described."

126. For an *Improved Burglars' Alarm;* Daniel E. Eaton, Assignor to self and Perley O. Eaton, Boston, Massachusetts.

Claim.—"Arranging both the igniting sector and escapement hammer on one rotary shaft, (controlled by a spring) in combination with so arranging the wick tube, the match holder, and the escapement rod, that immediately after the trigger bolt has been withdrawn from the escapement hammer, not only shall such hammer be thrown over upon the top of the escapement rod, but the igniting sector be caused to discharge the extinguisher off the wick tube."

127. For an *Improvement in Gas Brackets;* John R. Hunter, Baltimore, Maryland, Assignor to Samuel R. Blair, Philadelphia, Pennsylvania.

Claim.—"The use of the parallel arms or tubes, in combination with the revolving joints, so as to make the bracket or fixture self-sustaining in any position or elevation, and, at the same time, maintaining the burner in its level position, so as not to disturb a glass or shade."

128. For an *Improvement in Sugar Filters;* Charles E. Bertrand, City of New York.

Claim.—"The combination of a series or system of three or more filters with the arrangement of steam, water, and saccharine juice pipes, and their appurtenances, admitting of a continuous circulating motion of the liquid to be filtered from one filter into any of the others, until a clear and fair filtration is obtained; and, also, admitting of the working of the filters backward or forward, at pleasure, either from the top to the bottom or in the opposite direction, for the purpose of partially reviving the purifying properties of the charcoal until fully exhausted."

129. For an *Improvement in Cider or Wine Mills;* Samuel Krauser, Reading, Pa.

Claim.—"1st, Communicating a reciprocating as well as a rotary motion to the guiding disks. 2d, The use of the grinding disk with its peculiar movements, in combination with the two stationary sieves. 3d, The use of the stationary sieves for the purpose of pressing the whole or a part of the pumice through their meshes, and also causing them to assist in reducing the fruit to a pumice by providing their inner surfaces with sharp projections. 4th, The arrangement of the skeleton concave with reference to sieves. 5th, In combination with operating the screw by means of two vibrating tumblers, the use of the catches. 6th, In combination with the side screens, the application of the scraping wheels."

Re-Issue for October, 1855.

1. For a *Machine for Sawing Lumber;* Pinney Youngs, Milwaukie, Wisconsin; dated January 30, 1855; re-issued October 2, 1855.

Claim—"The employment of two pairs of shifting guides substantially as herein described, in combination with a circular saw, alternately in opposite directions. Also, setting the log or timber by means of the two screw shafts geared and operated by griping pawls, which act against stops at the end of the motions of the carriage, in combination with the arms and adjusting slides, to determine the degree or extent of set intended to be given to the log. And, also, in combination with the method of setting the log at the end of the several motions of the carriage, the method of throwing the setting apparatus out of gear by the bar which carries the log, to prevent the said bar with the holding dogs from approaching too near to the saw."

DESIGNS FOR OCTOBER, 1855.

1. For *Metallic Covers for Jugs;* Orrin Newton, Pittsburgh, Pennsylvania; dated October 9, 1855.

Claim.—"Making metallic covers and pitchers of the shape and pattern shown in the drawings."

2. For *Ornamenting Daguerreotype and other Mats;* Hiram W. Hayden, Waterbury, Connecticut; dated October 9, 1855.

Claim.—"The design of the ornaments surrounding the opening in the matting; and also, the design of the ornament formed on the surface of the matting.

3. For *Burial Cases;* Martin H. Crane, Assignor to Crane, Breed & Co., Cincinnati, Ohio; dated October 9, 1855.

Claim.—"The form and configuration of metallic burial case represented."

4. For *Cooking Stoves;* James Wager, Troy, New York; dated October 16, 1855.

Claim.—"The ornamental design and configuration of cook stove plates shown."

5. For *Cooking Stoves;* James Wager, Troy, New York; dated October 16, 1855.

Claim.—"The ornamental design and configuration of cook stove plates as represented in the drawing."

6. For *Parlor Stove Plates;* James Wager, Troy, New York; dated October 16, 1855.

Claim.—"The ornamental design and configuration of parlor stove plates."

7. For *Stove Plates;* Calvin Fulton, Assignor to Samuel McClure, Rochester, New York; dated October 30, 1855.

Claim—"The ornamental design of a stove plate, as represented."

8. For *Coal Stoves;* James Horton, Assignor to Leibrandt, McDowell & Co., Philadelphia, Pennsylvania; dated October 30, 1855.

Claim.—"The combination of ornaments, the whole forming an original design for a coal stove."

9. For *Stoves;* Andrew O'Neill, Assignor to O'Neill and Hunter, Portsmouth, Ohio; dated October 30, 1855.

Claim.—"The design for doors, top, and side plates of a stove."

10. For *Cooking Stoves;* Ezra Ripley and N. S. Vedder, Troy, New York, Assignors to "Johnson, Cox, Lasley & Co.," City of New York; dated October 30, 1855.

Claim.—"The combination and arrangement of the several ornaments and mouldings, as described, the whole forming an ornamental design for a cook stove."

NOVEMBER 6.

1. For an *Improvement in Machines for Sawing Marble;* Henry Burt, Newark, N. J.

Claim.—"The combination of the saw frame, pivoted, swinging, adjustable guide frames, and connecting rods, arranged and operated in the manner and for the purpose set forth."

2. For a *Method of Heating Air for Blast Furnaces;* Thomas W. Bakewell, Cincinnati, Ohio.

Claim.—"The heating of air to supply furnaces, by bringing the escape steam of an engine into direct and intimate contact therewith, in a suitable vessel, separate from the furnace, and previously to its admission thereto."

3. For an *Improvement in Whiffle Trees;* George C. Barney, Brookline, Mass.

Claim.—"Making a whiffle tree in two parts, and constructing them together and to the cross bar of the shafts."

4. For a *Bench Plane Iron;* J. Henry A. Bleckmann, Ronsdorf, Prussia.

Claim.—"The placing of a piece or a plate of steel between plates of iron, forming a plane iron."

5. For a *Lath Machine;* Andrew Blaikie and Walter Clark, St. Clair, Michigan.

Claim.—"The arrangement of the saw, separating plate, deflecting or guide plates, and feed rollers."

6. For an *Improvement in Brick Machines;* Alex. H. Brown, Washington, D. C.

Claim.—"1st, The combination of the outside plungers with the skeleton wheel, inside plunger, and moulds. 2d, Discharging the bricks by means of the ratchet stock, vertical bars, and inside plungers. 3d, The mode of regulating the amount of feed, through the action of the quadrants upon the inside plungers. 4th, Regulating the movement of the skeleton wheel upon the lower plunger."

7. For an *Improved Arrangement of two Beam Engines with Parallel Shafts;* Thos Doyle, City of New York.

Claim.—"The arrangement of two beam engines, in line with their cylinders, contiguous to each other, and the connexion of the piston ends of the beams, by an intermediate beam."

8. For an *Improvement in Automatic Lubricators for Railroad Axles;* Michael Egan, Ogdensburgh, N. Y.

Claim.—"The arm placed under the bearing, and made to descend into the grease and rise to the journal at each revolution of the axle, by being connected to the eccentric, or its equivalent."

9. For an *Improvement in Knitting Machines;* Arasmus French, Waterbury, Conn.

Claim.—"1st, The combination of the eye pointed needle, with the hoop. 2d, The method of opening and closing the clamps, for holding the hoops, by the use of the cams or wedges on the circle, when worked by the same eccentric which works the needle. 3d, The method of narrowing by giving a longitudinal motion to the arch bar."

10. For an *Improvement in Washing Machines;* Daniel Haldeman, Morgantown, Va.

Claim.—"The combination of the hinged arms, crank shaft, restraining hooks, and rubbing board, for the purpose of holding and operating said rubbing board in its proper position whilst washing, and to enable the operator to raise it out of the machine, to remove or replace the clothes, by simply throwing back the restraining hooks, and drawing the shaft (still pivoted to the arms) towards the end of the machine."

11. For an *Improvement in Self-Acting Mules;* John Harris, Lawrence, Mass.

Claim.—"The peculiar combination applied to the endless chain, and for effecting such variable movement, or "running in" of the carriage; the same consisting of the driving shaft, the clutch apparatus thereof, the barrel gear, the eccentric gear, and mechanism connecting the latter with the shaft of the endless chain, to the mechanism for producing regular movement of the chain in a reverse direction."

12. For an *Improvement in Locks;* D. W. G. Humphrey, Gray, Maine.

Claim.—"The indicator, movable ward plate, and lever."

13. For an *Improvement in Gas Holders;* Stephen Hill and William J. Wood, Rochester, N. Y.

Claim.—"The combination of the pipes, with the diaphragm within the gas holder, for the purpose of applying an equable pressure to fill the gas holder with gas, and to expel the gas therefrom."

14. For a *Saw-Horse;* Horace Lane, Windsor, Vermont.

Claim.—"The use of the spur to hold the wood or timber in its place on the same horse, while the sawyer is sawing wood or timber into fire wood, or into short pieces. Also, the use of the roller, the ratchet wheel, the lever, the dog and spring, the cord, the pulley wheel, the slide, the arbor, and the groove and spiral spring, combined with the saw-horse."

15. For an *Improvement in Machines for Splitting Leather;* Jeremiah A. Marden, Newburyport, Mass., and Henry A. Butters, Haverhille, Massachusetts.

Claim.—"Combining with the feeding apparatus or mechanism, by which the leather may be restrained in its delivery, so as to effect the reduction of "cockles."

16. For an *Improved Cutter Head for Rotary Planes;* William Nixon, Adrian, Mich.

Claim.—"1st, The double bevel of the cutter, in combination with the bevel on that

part of the stock or cylinder, which is in front of the cutter, so that the stock may act as a cap iron to the cutter, and to clear the shavings."

17. For an *Improved Composition for Kindling Fires;* Bernard O'Reilly, City of New York.

Claim.—"The fire lighting compound, formed by the admixture of the several ingredients, in about the proportions set forth."

18. For a *Mortising Machine;* Loomis E. Payne and Orris Pier, Stowe, Vermont.

Claim.—"A double semicircular mortise bit, or gauge, arranged so as to clear itself thoroughly in its action, and this, in combination with the double eccentric plate, to regulate the motion to and fro of said mortise bit."

19. For an *Improvement in Chain Locker Pipes;* Charles Perley, City of N. Y.

Claim.—"The locking piece applied to the chain locker pipe, and in combination with said locking piece and flanches, I claim the cover c."

20. For an *Improvement in Steam Boilers;* Henry N. Pettengill, Rockford, Illinois.

Claim.—"The arrangement of the flues, the water chambers and projections, with the feed water pipes combined."

21. For an *Improvement in Marble Sawing Machines;* Robert G. Pine, Newark, N. J.

Claim.—"The frame, connected by jointed rods, to rods working in sockets, which are fitted loosely on rods."

22. For *Improvements in Rotary Steam Engines;* Elias Matteson, Dayton, N. Y. Walter M. Parris, Detroit, Vt., and Hervey Parris, Pawlet, Vermont.

Claim.—"1st, The cut-off crank and anti-friction roller, in combination with the ellipses and balance beam, when so constructed, as to alternately open and close the cut-off valves, for the purpose of effecting an adjustable cut-off. 2d, The air spring to steam wheels, when so constructed as to have direct influence on the steam piston, and by its reciprocal action to maintain a steady, even motion of the engine, when in unison with the cut-off."

23. For an *Improved Mode of Hanging Window Sashes;* J. W. Ross, Zanesville, O.

Claim.—"Attaching the straps to the sashes, said straps passing in reverse direction, around pulleys, on a shaft in the style of the casing, the pulley being attached permanently to the shaft, and the pulley placed loosely upon it, and the pulleys being connected and disconnected when desired, the pulley having a pulley attached to it, to which pulley an elastic band is attached, said band being also attached to the sash."

24. For an *Improvement in Clothes Clamps;* James Sadgebury, Philadelphia, Pa.

Claim.—"The grooved button, in connexion with the grooved protuberances."

25. For an *Improvement in Drilling and Boring Machines;* Samuel M. Shryock, Hopkinsville, Kentucky.

Claim.—"Supporting the rests by rack and pinion of shaft, and combining the same with movable and fixed pulleys, as that the rests may be moved upward with any required velocity, or be dropped from the drill, at the will of the operator, during the revolution of the boring shaft."

26. For an *Improvement in Arranging and Feeding Screw Blanks;* Elliot Savage, East Berlin, Conn.

Claim.—"The combination of the reciprocating slider, the receiver or hopper, and the inclined conductor. Also, combining the spring pressure with the slider and hopper, and so as to cause the slide to operate laterally, with respect to the screw blank."

27. For an *Improvement in Sewing Machines;* Isaac M. Singer, City of New York.

Claim.—"The employment of the two eye-pointed needles, carrying its appropriate thread, and two working in unison, in combination with a shuttle, or equivalent therefor, to effect the concatenation of the two sets of stitches."

28. For a *Self-Feeding Atmospheric Lubricator;* John Sutton, City of New York.

Claim.—"An arrangement of means constructed on or within the cap or cover, (of the reservoir containing the oil, or other lubricating material,) sufficiently distant from

oil to never be in contact with the same; by the adjusting of which, the passage or passages leading from the reservoir to the atmosphere, may be entirely or partially opened or closed at will, thus causing an increase or decrease of the feeding of the oil to the part receiving lubrication. When properly adjusted, the dome may be firmly secured down, when nothing can interfere with the regulating part."

29. For an *Improvement in Door Springs;* Amos Westcott, Syracuse, N. Y.

Claim.—"Adjusting the jointed lever, and also adjusting the pulley."

30. For a *Sofa Life Boat;* Peter Van Zile, Searles M. Griffin, and J. W. S. Dey, City of New York.

Claim.—"The structure, consisting of two buoyant parts, so constructed, that when separate, they shall each form a settee or sofa, and when united, a life boat."

31. For a *Chimney Cap;* John W. Davies, Richmond, Virginia.

Claim.—"The combination of the cap and the cone, with the tubes."

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32. For an *Improved Marble Sawing Machine;* George W. Bishop, Brooklyn, N. Y.

Claim.—"Operating the saws of stone sawing machines, by placing the lever on a tube, which has an internal screw thread cut in it, and is fitted on a screw rod, whereby the lever may, by turning the tube, be raised or lowered, to suit the height of the sashes."

33. For an *Improvement in Hanging Window Sashes;* Michael Bomberger, Hummelstown, Pennsylvania.

Claim.—"The application to window frames in which ropes and pulleys are used to support the sash, of the piece called the "rope hider," using for the purpose of concealing from view the ropes and pulleys, a strip of wood, or piece of any other material which will produce the intended effect."

34. For an *Improvement in Upsetting Tire, &c.;* Hiram Abbot, Wakeman, Ohio.

Claim.—"The arrangement of the parts of my machine, to wit: the bed plate, the adjustable jaws, (operated upon by the eccentric levers and spiral springs,) the eccentric levers, the elongated jaws, (which form the slot by being inserted, or diminished in width, through the agency of the eccentric lever and the spiral springs,) the levers and the eccentric lever."

35. For a *Weighing Attachment for Faucets;* Job Brown, Lawn Ridge, Illinois.

Claim.—"Attaching or connecting the frame to the scale beam, by means of the pulley resting upon the spout end of the beam, and attaching a cord to the platform of the frame, and the gate or spigot of a faucet of the vessel."

36. For an *Improved Marble Sawing Machine;* William C. Chipman, Sandwich, Massachusetts.

Claim.—"The rollers."

37. For an *Improvement in Attaching Shafts to Axles;* Thomas Chope, Detroit, Mich.

Claim.—"Attaching the shafts to the front axle, by means of the curved plates attached to the back ends of the shafts and the cylinder, secured in the ends of the projections which are attached to the front axle, the cylinder having notches made in their peripheries to receive the lips on the ends of the plates."

38. For *Improved Devices for Partially Excluding Dust from Railroad Cars;* Virgil P. Corbett, City of New York.

Claim.—"1st, The employment of the valves on the ends of the chambers, when said valves are so constructed as to leave small exhaust passages when closed, between the bottom of the valves and the car, and so arranged that one of them, for instance, shall be open, while the other is closed, as the car travels in one direction, and vice versa, if traveling in an opposite direction. 2d, Having the mouth of the pipe elevated above the highest point of the escape passages, in combination with the construction, arrangement and operation of the valves and chamber."

39. For an *Improvement in Making Boring Implements;* Ransom Cook, Shelburne Falls, Massachusetts.

Claim.—"The method of forging and shaping the lips and heads of the particular kind of boring implements, by the successive stages of die stamping."

40. For an *Improvement in Seeding Machines;* E. Darwin Curtis, Mt. Morris, N. Y.

Claim.—"Providing the forked distributing tube, with a wedge-shaped flap valve, arranged in relation to the forks, as specified."

41. For an *Improvement in Ring and Gudgeons for Bottle Fastenings;* Jos. C. Day, Hackettstown, N. J.

Claim.—"1st, The construction of the hoop with two gudgeons thereon, one of which is made open, or divided in halves, and which, when in actual use, are brought together, thereby forming one gudgeon, which, with that on the opposite side, are the recipients of the gudgeon boxes. 2d, Securing the two half gudgeons together, and consequently, the collar to the bottle by means of one of the gudgeon boxes of the bail."

42. For an *Improvement in Supporting Jacks;* John Fouser, Philadelphia, Pa.

Claim.—"The lever with its sliding block, having any convenient number of recesses, in combination with the adjustable screw coupling, and its sliding block."

43. For an *Improved Marble Sawing Machine;* Luther B. Fisher, Branch County, Michigan.

Claim.—"Operating the frames of stone sawing machines, by means of the segments, in combination with braces, arms, and chains or straps."

44. For an *Improvement in Separating Pins;* Thaddeus Fowler, Waterbury, Conn.

Claim.—"The method of separating the imperfect from the perfect pins, by the use of an endless apron, having both a longitudinal and a lateral oscillating or rocking motion."

45. For an *Improvement in Rotary Engines;* John H. Hathaway, Millbury, Mass.

Claim.—"Moving the head by means of a radial arm, having its centre of motion corresponding to the centre of the shaft, so as to withdraw the head from the cylinder, before elevating it."

46. For a *Lathe Chuck;* Eli Horton, Windsor Locks, Conn.

Claim.—"In combination with the opening on the front plate, for the introduction of the solid jaws, the hub on the back plate, for closing said opening and retaining the jaws in their respective slots. I also claim the locating of the circular rack in the deep recess or groove formed between the flanches, which not only form a tight casing to protect it from chips, filings, &c., but also support it, as well as the shanks of the screw bolts."

47. For an *Improved Marble Sawing Machine;* George W. Hubbard, Middletown, Connecticut.

Claim.—"Constructing the adjustable guides and permanent guides of stone sawing machines."

48. For an *Improvement in Argand Gas Burners;* Charles H. Johnson, Boston, Massachusetts.

Claim.—"Making the distributor with a catch, lip, flanch, or spout extending around its bottom. Also, combining with the Argand burner, a conical deflector, or the cone and its interior rod and bulb, the same being arranged in the middle of the air chamber of the burner."

49. For an *Improvement in Tobacco Presses;* Rudolphus Kinsley, Lynchburgh, Va.

Claim.—"The construction and employment of a press bar, or compresser, in which the article to be compressed can be put and placed under the press, and when compressed can be retained in that position and removed from the press till set, while the press is liberated for the operation."

50. For an *Improved Marble Sawing Machine;* William B. Kimball, Peterboro', New Hampshire.

Claim.—"Driving the saw frames or gates by means of the jointed pitmans and bar, in combination with the geared segment and crank."

51. For a *Water Metre;* Samuel Krauser and Christian Ritter, Reading, Pa.

Claim.—"1st, Measuring or indicating the passage of a quantity of water through a pipe, by allowing a small graduated portion thereof to escape and waste into a measuring and retaining receiver, or other vessel employed for that purpose. Also, in combination

with the rod and plug, the spring and adjusting screws, for the purpose of regulating the passage of the water through and into the metre. Also, the drip, in rear of the plug, to cause the water from the slot to drop into the funnel, and thence into the receiver. Also, the inclined angular recesses on each side of the slot, on the inner face of the plate, for the purpose of carrying away from the slot any impurity or solid matter in the water."

52. For a *Self-Feathering Adjusting Tide Wheel;* Richard L. Nelson, Ocala, Florida.

Claim.—"The arrangement of the floating cam, and the floating self-feathering blades, or buckets, when said cam and blades are made to rise and fall with the rise and fall of the steam or water that drives the wheel. Also, in combination with a tide or current water wheel, the self-acting water brake, for causing the variable force of the current to be applied to the regulating of the speed of the wheel."

53. For an *Improvement in Corn Planters;* Thomas R. Markillie, Winchester, Ill.

Claim.—"The reciprocating weighted markers, acting, to perform the double function of operating the planting apparatus and making the hills."

54. For an *Improvement in Giving Tension to the Endless Band of Throstle Frames;* Joseph Morse, Woonsocket, Rhode Island.

Claim.—"The arrangement of the endless band to run to and fro, between every one of the spindles and the drum, and around a pulley carried by a slide, which is movable on suitable guides, and has a weight attached to it by a cord, so arranged as to draw the said slide in the proper direction to produce tension on the band."

55. For an *Improvement in Machine for Cutting Boot and Shoe Uppers;* Jean Pierre Molliere, Lyons, France; patented in France, August 19, 1854.

Claim.—"The use of a large bed plate, pressed up against a resisting body, by steam or other equivalent power, by which a large number of different parts are cut out from a skin, by different cutters at the same time."

56. For an *Improvement in the Mode of Hanging Carriage Bodies;* Ansel W. Porter, Little Falls, New York.

Claim.—"The free roller connexion between the carriage body and the longitudinal levers, for permitting all shocks to be conveyed through the said levers to the springs, without direct action on the body."

57. For an *Improvement in Lasting and Applying Soles to Shoes;* Charles Rice, Boston, Mass., and Sylvanus H. Whorf, Roxbury, Massachusetts.

Claim.—"The holding clamp and last, as used together and in connexion with the pressing or puncturing mechanism or both, for the purpose of fixing soles to shoes, by cement."

58. For an *Improved Compound Projectile;* Sylvanus Sawyer, Fitchburg, Mass.

Claim.—"Combining with the but or flat rear end of the cylindro-conical iron shell, a layer of lead, or softer metal than that of which the body of the shell is composed, and united or not to a layer of such metal, extended around the sides of the shell; the same operating while the shell is being projected through the bore of a gun, by a discharge of the powder therein. Also, making the rear part of the shell tapering or conical, combining therewith a ring or annulus of lead, or its equivalent. Also, confining the explosive screw cap to the body of the shell, by means of a softer or yielding metal or casing, which, when the cap or shell strike an object, shall give way under the force of the blow, and let the cap down with force, so as to compress the percussion water, or priming in it, or on the main screw, stopper, or plug, and so as to create an explosion thereof."

59. For an *Improvement in Machines for Adding Numbers;* Nathaniel S. Saxton, Riverhead, New York.

Claim.—"The spiral scale of numbers, combined with the traversing gnoman."

60. For an *Improvement in Preparing Artificial Teeth;* Barclay A. Satterthwait, Lima, Ohio.

Claim.—"The improvement in making whole or half sets of artificial teeth, gums and plates, entirely of porcelain, by modeling porcelain material around porcelain teeth or mounting porcelain teeth on porcelain plates."

61. For an *Improvement in Refrigerators;* D. W. C. Sanford, Cincinnati, Ohio.

Claim.—"The arrangement for causing the perpetual rotation of the whole of the air contained within the refrigerating apartments, said arrangement consisting, when the refrigerator is closed, of an endless passage or chamber, the walls, shelves, and ice receptacle of which, are so placed and constructed, that the air is compelled to circulate through the entire apartment or apartments, and from which the water of the melting ice is discharged immediately from the refrigerator, instead of flowing between its walls."

62. For an *Improvement in Forming Heads on Bedstead Screws;* H. N. Sherman, Birmingham, Connecticut.

Claim.—"Giving the lavers, to which the dies are attached, three separate and distinct movements in succession; the first lateral movement causing the smaller parts of the dies at their inner ends, to grasp the end of the rod; the second and sliding movement causing the collar to be formed and the square partially formed; and the third lateral movement perfecting the square and completing the head. Also, the combination of the dies with the rod, the rod serving as a stop at the commencement of the operation, and also, serving subsequently as a plunger, to compress the metal forming the square snugly within the dies."

63. For an *Improved Mode of Securing Shafts to Axles;* Alfred E. Smith, Bronxville, New York.

Claim.—"Connecting the stems of the shafts or thills with the eye staples by means of a spring or springs, acting laterally against the faces of the eye staples."

64. For an *Improvement in Processes for Making Zinc White;* Samuel Wetherill, Bethlehem, Pennsylvania.

Claim.—"The process of producing the white oxide of zinc from the ore of that metal, by the direct application of the fuel to the ore, in the crushed state, and in admixture therewith, in combination with a blast of atmospheric air, introduced in numerous small jets, to the charge of mixed ore and coal, in a thin layer."

65. For an *Improved Marble Sawing Machine;* Charles F. Warren, Malden, Mass.

Claim.—"Giving the saws a lateral vibrating movement in the saw frame, as the saw frame and saws work longitudinally by means of the rack, pinions, grooved sectors, and racks."

66 For an *Improvement in Straw Cutters;* Loren J. Wicks, Paterson, N. J.

Claim.—"Hanging the knife to a crank shaft and to a pivoted pitman, for the purpose of giving the curvilinear motion."

67. For an *Improvement in Planing Machines;* James A. Woodbury, Winchester, Massachusetts.

Claim.—"Making both of the edge cutters adjustable, in such manner, that the board can be fed in from either side of the machine, double guides being provided for the purpose."

68. For *Improved Machinery for Raising Ice from Rivers, &c.;* Cornelius R. Wortendyke, City of New York.

Claim.—"The method of adapting the ice elevating chain, to work under changes in the level of the water, by jointing the frame, carrying the lower wheel of said elevating chain to the lower end of the fixed incline, and sustaining the said frame work, wheel and chain on scows or floats. Also, the movable bottom, fitted and arranged to pass the ice from the movable to the stationary part of the incline. Also, in combination with the frame work jointed to the lower end of the fixed incline, carrying the lower wheel of the elevating chain, the adjustable slide journal boxes and screws, for regulating the tension of said elevating chain, as the water rises or falls."

69. For an *Improved Road Scraper;* Reuben W. Oliver, Assignor to self and Horace Hoyt, East Aurora, New York.

Claim.—"Supporting the forward end of the scraper, upon levers which rest upon the wheel, or their equivalent, as a fulcrum, and extending back of the scraper, for the purpose of operating conveniently, the back end of the scraper resting upon a fixed support. 2d, Hanging the bottom of the scraper to the sides. 3d, Securing the return of bottom to the position for loading by the chains, or their equivalent, attached to the said bottom and to the levers."

MECHANICS, PHYSICS, AND CHEMISTRY.

For the Journal of the Franklin Institute.

United States Mail Steamer Arago. By ERASMUS W. SMITH, Resident Engineer to the "New York and Havre Steam Ship Company."

Vessel built by Jacob A. Westervell & Sons, under the superintendence of Captain William Skiddy. Engines, by Stillman, Allen & Co.

DIMENSIONS.—

Length on deck,	292 feet.	
Breadth of beam,	40 "	8 inches.
" over all,	67 "	6 "
Depth of hold,	31 "	6 "
Tonnage, custom house,	2260.	
" carpenters' measurement,	3200.	
Diameter of cylinders,		65 inches.
Length of stroke,	10 feet.	
Diameter of Paddle wheels,	33 "	
Width of paddles,		20 "
Length "	10 "	
Shafts, of wrought iron,		
Diameter of crank journal,		19 inches.

BOILERS—Two iron flue—one forward and the other aft the engines—

Each affording for fire and heating surface,	4000 sq. feet.	
Total amount of grate surface,	650 "	
Boiler shells back of furnaces.		
Diameter of cylinders,	14 feet	6 inches.
" " steam chimneys,	7 "	6 "
Each boiler has 6 furnaces in two tiers.		
Average length of grates,	6 "	6 "

Remarks.—The *Arago* has three decks, the upper or spar deck being but little encumbered by houses of any kind. The galley, dining saloon, ice houses, &c., being on the berth deck below, gives the spar deck an unusually plain, roomy, sea-worthy character. The materials employed in her construction are of the best description. The floor timbers are of oak, sided 15 inches, and joined accurately together, forming a solid mass of timber from end to end of ship, and extending transversely to turn of bilge. Frames, strengthened by diagonal iron truss work, composed of bars 5 inches wide, $\frac{7}{8}$-inch thick, cross-laid at angles of 45°, riveted together at their intersections with each other and each bar bolted to every frame it crosses. The truss work is applied to inside of frames, one-half the bars being countersunk flush into frames, the remaining overlapping half recessed into ceiling.

"Captain Lines has devoted his whole time to supervising the details throughout the ship, which are probably as complete and as commodious and comfortable as any yet fitted in this country. Commencing on the spar or upper deck, forward, are seen Brown's patent anchor gearing, stated to be the most efficient apparatus for working cables and anchors at present known, combining strength, security, and great saving of room and labor. It was put in operation during the trial trip, at Sandy Hook, when the anchor was weighed with the greatest ease. From the foremast, going aft, are several covered stairways, leading down to the different cabins, with large skylights. By the mainmast is a house, protecting the main stairway, containing cushioned seats for passengers—abaft this

is a range of large skylights and one of Brown's patent capstans; on the after part of this deck (300 feet long) is a circular house protecting the helmsman, with a stairway to the dining saloon, a state room for the captain and one for the first officer. In the centre is a sitting room, from which is entered by folding doors a convenient smoking room, containing card tables, and a private passage on each side to the water closets. This whole deck is enclosed with strong locust stauncheons and rail, and a galvanized iron netting, imparting a very light and airy appearance. On the outside are suspended eight large life boats (Francis's patent,) fixed with oars, sails, and water casks, &c.

"On the main deck, commencing and descending by the stairway aft, you enter the dining saloon, 100 feet long, with open galleries amidships, enclosed by a handsome polished railing, over which, on the spar deck, are the large skylights, imparting light and air through these galleries down on to the next deck, with beautiful effect. A double range of hard wood polished tables, with cushioned seats, covered with crimson plush, extend the whole length of the saloon. Over these tables suspended are shelves or racks, containing the different cut glass and bottles required at table. Over each table is also suspended a beautiful French carcel lamp. The bulkheads on either side of the saloon are all of the most recherche woods, assorted and highly polished. They are intersected by alcoves with circular arches, leading to a suite of state rooms communicating with each other. Each alcove has a large light opening through the side of the ship; also, one in each state room. These rooms each accommodate two persons with berths, sofa, and toilet fixtures. Advancing forward, you pass the mainmast and stairway. On the right you enter the ladies' saloon, tastefully decorated with table, cushioned seats, and mirrors. This opens into a private boudoir or dressing room, adjoining which are three water closets and a bath room. Opposite the ladies' saloon is the captain's room, conveniently and tastefully fitted up. Adjoining, going forward, you enter the steward's pantry, containing bar room, steam table, plated ware, and cases for silver, &c., &c., beautifully arranged, under the direction of Mr. Allen, chief steward. Continuing on from the ladies' saloon, through an extensive and well lighted passage, leading forward 150 feet, are placed the ice and vegetable houses, between the side of the ship and between the paddle or guard beams, where, in all steamers, it is usually damp. These houses are entirely out of sight, and communicate with the upper deck. Beyond this the place is occupied with state rooms and alcoves, lighted and arranged similarly to those already described aft. At the extreme end, forward, is a ladies' boudoir and water closet. On the left side of this passage are the engineer's room, state rooms, barber's dressing room, and a half circular stairs leading to the upper deck. Crossing by an alcove to the port side, a similar half circular stairway from the upper deck, conducts to the forward cabin passengers' dining saloon, well lighted and ventilated, and fitted up with Thompson's patent life tables, and all other conveniences similar to the after saloon and pantry. Several state rooms extend forward of this saloon to the store-room and forcastle. Proceeding aft through a passage, either side is occupied with rooms for officers, servants, mess rooms, galleys, ice houses, lamp room, butcher's and baker's rooms, and large cabin galley, and steward's pantry.

"On the berth deck, under the main deck, is seventy feet long, lighted and aired by the galleries and skylights already described. The longitudinal bulkheads are delicately ornamented and beautifully grained in oak, having side sofas, covered with crimson plush. Alcoves intersect every 12 feet, leading into the different state rooms, all of which are well lighted and ventilated; in each room are two berths, sofa, and toilet fixtures, &c., similar to those above. Rooms communicate where required by families. Beyond the forward stairway, leading up to the dining saloon, are rooms for servants, stores, luggage, &c.; between this and forward lower cabin, the space is occupied with engines, coal, &c.; after this, descending by a stair-way, between the two half circular stairs forward, you land in a similar saloon or passage to that in the lower cabin aft, with alcoves leading to state rooms. There are water closets on each deck, all ventilated on a new plan, with Perley's patent ventilators.

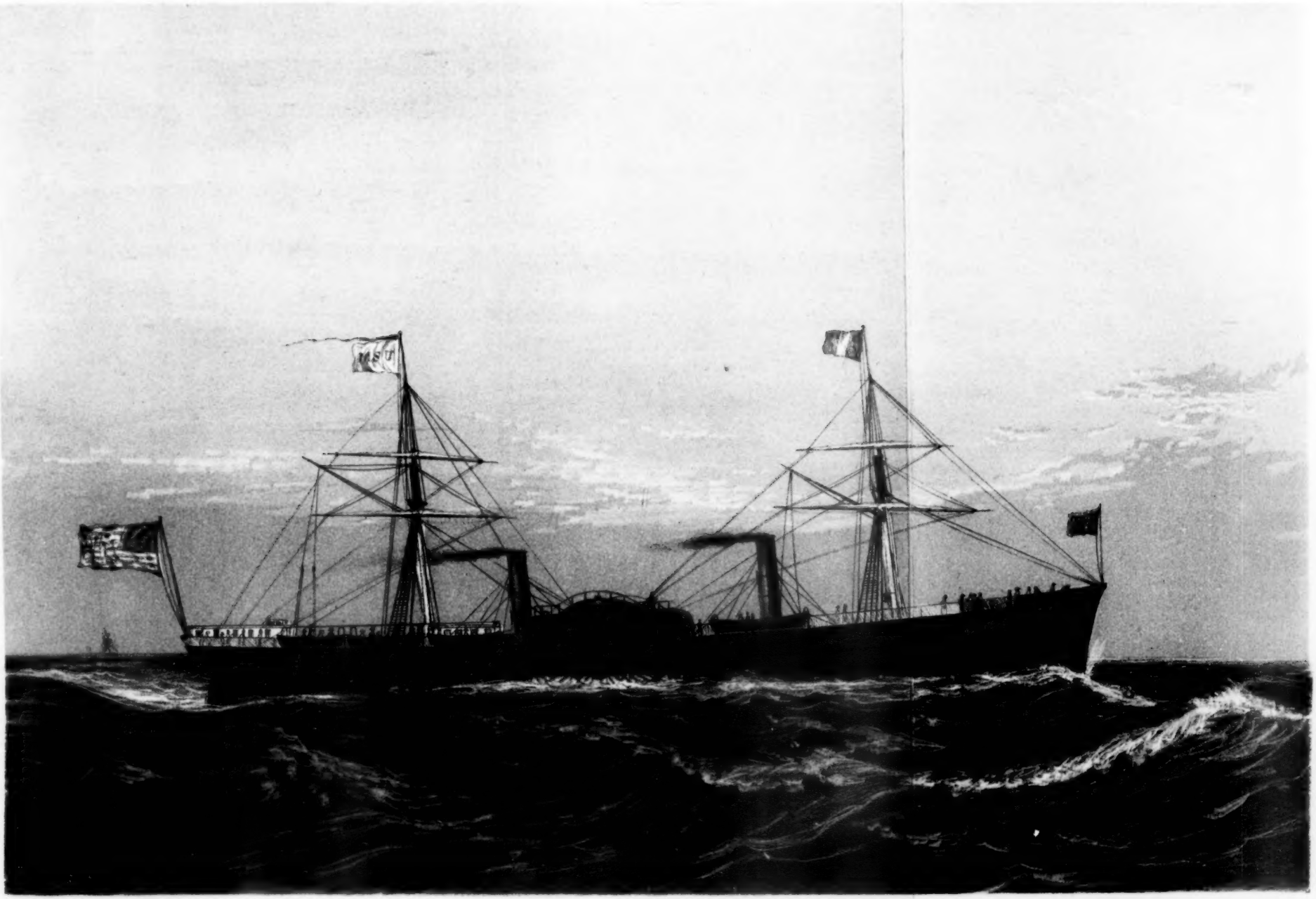
"The ship is thoroughly ventilated on the outside with Perley's patent ventilators, between every frame, thus allowing free circulation to the floor timbers.

"The *Arago* can accommodate, comfortably, 250 passengers, and carry about 900 tons of cargo, besides 900 tons of coal. Her draft, with all on board, is 17 feet 4 inches."

The painful experiences of the past have not been forgotten. Most judicious means have been adopted to prevent the sinking of the ship, and also, for pumping water and extinguishing fire. The engines and boilers are enclosed in a tight compartment composed of longitudinal and transverse bulkheads of two thicknesses of two inch plank cross laid. Other transverse bulkheads divide the ship forward into several sections. The coal bunkers are on either side of ship, opposite engines and boilers, and between side of ship and longitudinal bulkheads. The bunkers communicate through doorways rimmed with iron and fitted with iron slide gates, which can be closed in case of disaster at sea. The advantages of such an arrangement in case of collisions with vessels, rocks, or iceburgs is incalculable.

The engine department is fitted with two very large fire and wrecking pumps, each operated by a separate steam cylinder, and capable of delivering 700 gallons of water per minute. They are three times the size commonly used on steamships, and got up expressly for the *Arago* by the builders of the engines. They are provided with a small independent boiler for working in port, but at sea are connected with the main boilers.

The arrangement of engines is peculiar, and the first of the kind. The cylinders stand nearly opposite each other fore and aft, inclining, when on their centres, towards a vertical line through centre of shaft, an angle of 24°. The usual centre-shaft, centre-shaft cranks, and centre-shaft pillow blocks, are dispensed with, the arrangement affording means of connecting the engines at right angles by means of a simple union link, which is made of wrought iron and forged in one piece. As the link suffers only a tensile strain, it is considered safer than a centre-shaft which suffers both a torsional and transverse strain. The performance of the union link for two voyages is highly satisfactory. The steam and exhaust valves are of the usual double beat balance description; the valve chambers, induction and eduction pipes, are cast with the cylinder, thereby



LITH. OF ENDICOTT & Co N.Y.

NEW YORK AND HAVRE STEAM SHIP COS.

U. S. MAIL STEAMER ARAGO.

2260 TONS.

affording a very short and direct connexion therewith. The rock shaft and valve gear combine the latest improvements, and are fitted with "Allens & Wells'" variable cut-off, which is adjustable for cutting off at different points of the stroke by the hand of the engineer while the engine is in motion. Each engine is provided with "Pirsson's" patent surface condenser, supplying 2000 square feet of condensing surface. Tubes, of copper, one inch diameter.

Until late years, the oscillating engine was not considered so well adapted for ocean steam ships as the side lever, beam, and other stationary cylinder engines, extensively made in this country and Europe. The oscillators were considerably used in the latter place, but on comparatively a small scale, when they were invariably fitted with the slide, steam, and exhaust valve, and if a separate expansion valve was introduced, it was generally the old fashioned swing-valve, inserted in the steam pipe *outside* the cylinder trunnion, which necessarily occasioned a great loss in the expansion of steam. Thus arranged, it could not compete in service for an equal amount of fuel, with similar size, stationary cylinder engines, having better valve arrangements.

To American engineers, and chiefly to Horatio Allen, Esq., of the house of Stillman, Allen & Co., belongs the credit of modifying and improving the oscillating engine, until it now combines the same fuel saving appendages adapted to the best stationary cylinder marine engines, while its efficiency in other respects is unimpaired, and it may be considered a successful competitor with the side-lever and other popular forms of engines.

American engineers can also take to themselves the credit of having led the way in building the *largest* oscillating engines. Stillman, Allen & Co., in 1851, built a pair of oscillators for the steam ship "*Golden Gate*," of 85 inches diameter of cylinder, and a stroke of 9 feet. In 1852, they constructed a single oscillator for the "*John L. Stevens*," of 85 inch cylinder, 9 feet stroke; and the following year, one for the "*Augusta*," of 85 inch cylinder, 8 feet stroke; then followed the "*Knoxville*" and the "*Arago*," by the same builders.

When it is considered that in the arrangement of the "*Arago*," when compared with side-lever double engines similar to those of the "Collins" and "Cunard" steamers, two steam cylinder cross-heads, four cylinder side connecting links, four side levers, four cross-tail links, two connecting rod cross-tails, two connecting rods, two centre-shaft cranks, one centre shaft, two centre-shaft pillow-blocks, in all *twenty-three parts* of what may be considered the *harness* between the power and resistance are dispensed with, and the piston-rod attached directly to the crank-pin; some idea of its simplicity may be conceived. The risk of breaking any *one* of the above enumerated twenty-three parts, which would disable the engine, is avoided. The union link, substituted to connect wheel-cranks in place of centre-shaft, is the only part *added* between the piston rod and paddle wheels, and is so simple of construction as to create no fears of its frailty.

The cylinder trunnion, which some eminent engineers have considered a questionable feature of the oscillating engine, have invariably worked well, and I believe that none of the American engines have given

difficulty from that source, there being no beam in the arrangement through which the power is transmitted, the pressure on the cylinder trunnions is only one-half what it would be on beam centre journals; the bearing surface of the trunnion journals must necessarily be large to give sufficient capacity of steam and exhaust opening; and, moreover, the current of steam constantly passing through the trunnions when the engine is in motion, tends to keep them at a temperature corresponding with that of the circulating steam and prevent them from accumulating heat of a higher degree.

Abstract of "Arago's Log" on first Outward Passage.

June, 1855.	Distance.	Revolutions.	Average steam.	Tons coal, (anthracite.)
	Miles.		lbs.	
3	190	15,144	30	37
4	215	15,064	30	41
5	228	17,708	30	44
6	252	19,716	30	49
7	268	19,564	30	50
8	276	19,807	30	46
9	243	20,905	30	47
10	260	20,346	25	47
11	270	21,055	30	47
12	250	20,107	22	44
13	278	21,115	25	45
14	294	22,620	25	47
15	120			
	3144			

Stopped off Cowes, 10 P. M.; deduct 4 degrees 50 minutes for difference in time, and 5 degrees 10 minutes for stoppages and slowing, leaves 12 days passage.

Homeward Passage from Cowes.

July, 1855.	Distance.	Revolutions.	Average steam.	Tons coal.
	Miles.		lbs.	
5	125	18,198	26	36½
6	268	20,827	30	45½
7	268	21,693	32	42½
8	248	20,867	30	50½
9	270	21,756	30	54¼
10	250	21,059	30	53
11	198	19,345	25	52
12	273	22,648	30	53
13	282	23,735	30	49½
14	288	23,372	30	45
15	304	23,645	30	45

The accompanying illustration (Plate V.,) exhibits the style of rig, and is a correct likeness of the ship.

For the Journal of the Franklin Institute.

Remarks on Calculating Machines.

The October number of the *London Practical Mechanics' Journal*, in an article on the Paris Exhibition, notices a calculating machine by Scheutz, of which it explains the movement thus—

"Supposing it is desired to work out the cubes of the numbers 1, 2, 3, 4, &c.—as simple a case as can perhaps be taken—let us set down a few of these cubes, thus:—

1		8		27		64		125	
	7		19		37		61		
		12		18		24			
			6		6				

"In the second row, and below the spaces of the terms above, place the differences between those terms. In the third and fourth rows similarly place the differences between the terms of the second and third rows respectively. We find that the terms of the fourth row are all sixes (and this will be the case, however many terms we set down in the first row.) From this we derive a rule for obtaining the cubes by the repeated addition of the constant number 6. In working out this simple calculation in the machine, four horizontal rows of wheels will be called into play, the top row representing the products. At starting, the second row will be set to indicate 1, and the fourth, 6, whilst the first and third rows will show zeros, as at A.

0	1	1	8	8	27	27	64
1	1	7	7	19	19	37	37
0	6	6	12	12	18	18	24
6	6	6	6	6	6	6	6
A	B	C	D	E	F	G	H

"At the first movement of the machine, the amounts indicated by the second and fourth rows are added respectively to the first and third, as at B, the top one indicating the cube of 1. At the next movement, the number indicated by the third row is added to the one immediately above, as at C. It requires two movements, however, to complete a stroke or calculation of the machine, as every number indicated must be added to that above it, the alternate ones being operated upon at each movement. Thus, at the next movement, the second and fourth numbers are added to the first and third, as at D, making the top figure 8—the cube of 2. Two more movements produced the alterations shown at E and F, the latter showing the cube of 3, and the changes G and H show the cube of 4. Proceeding in this way, each couple of movements produces the cube of a number differing from the last by one. All regular series can be calculated in this manner, as can all tables the terms of which, when treated as above, show a constant difference after a less or greater number of operations."

It is curious that figures may be raised to any power by a similar process to the above, and the rule to ascertain the number of movements required and the constant difference for any exponent is as follows:—

Power.	Movements.		Constant difference at last movement.
Square or 2d,	2	$\times 1$	= 2
Cube or 3d,	3	$\times 2$	= 6
" 4th,	4	$\times 3 \times 2$	= 24
" 5th,	5	$\times 4 \times 3 \times 2$	= 120
" 6th,	6	$\times 5 \times 4 \times 3 \times 2$	= 720
" 7th,	7	$\times 6 \times 5 \times 4 \times 3 \times 2$	= 5,040
" 8th,	8	$\times 7 \times 6 \times 5 \times 4 \times 3 \times 2$	= 40,320
" 9th,	9	$\times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2$	= 362,880 &c., &c.

Practically this would complicate a calculation, although it is obvious that in the calculating machine referred to, any power could readily be indicated. It is, however, a curious property of numbers.

I annex an example for 5th power; the 5th power of

	1	2	3	4	5	6	7	
is	1	32	243	1024	3125	7776	16807	
difference is	31·	211·	781·	2101·	4651·	9021·		1st movement.
" "	180·	570·	1320·	2550·	4380·			2d "
" "	390·	750·	1230·	1830·				3d "
" "	360·	480·	600·					4th "
" "	120·	120·						5th "

J. V. M.

Nasmyth's Improved Process of Puddling Iron.

To the Editor of the Journal of the Franklin Institute.

The announcement made in the September number of the *Journal*, p. 209, under the above caption, that we were assignees of the patent for the United States, was an error which has arisen probably from the fact that we had, in Mr. Nasmyth's name, applied for such a patent in this country.

Mr. Nasmyth's claim has, however, been rejected by the Patent Office, on the ground that it conflicts with the patent issued to Guest and Evans by the English Patent Office, in 1840, and described in the *London Repertory of Patent Inventions*, Vol. xvi, p. 341, by reference to which, it will be perceived that the principle of both possess, viz., the application of steam beneath the surface of the molten metal, is the same, although in our judgment, Mr. Nasmyth's application is far more simple and less likely to derangement than the former, and perhaps these advantages may be all that is required to bring the process into general use. Be that as it may, we take occasion to say that Mr. N's. accounts of his success in England in producing by this method a cheaper and better iron, are such as to warrant us in expressing the hope that some of the leading iron firms in this country may take it up.

MERRICK & SONS.

Philadelphia, November 15, 1855.

For the Journal of the Franklin Institute.

Remarks on the Steamer "Lancefield."

HONG KONG, CHINA, August 4th, 1855.

To the Editor of the Franklin Institute Journal.

A new Steamer called the "*Lancefield*," arrived on this station about a month since from England. She is owned by the House of Jardine, Matheson & Co., of Hong Kong, and runs between Bombay or Calcutta and this place in the opium trade. I visited her a number of days since, when I obtained the following information, which I transmit to you, as I suppose you take an interest in all that is transpiring in our profession, even in this remote region.

She has two engines—constructed by Napier & Sons of Glasgow—of the four piston rod variety, connected direct, *i. e.* without the inter-

vention of gearing to the screw shaft, with trunk air-pumps as her engineer called them, but which are simply plunger pumps; the plungers working through stuffing boxes in each end of the pump; and the difference in the areas of the back and front end of the plunger is that which is effective in pumping off the air and water. The cylinders, 52 inches in diameter, by 3 feet stroke of piston, each, are set horizontally, side by side, on one side of the shaft, and the air-pumps in a similar manner on the opposite side. The piston rods, passing above and below the shaft, are connected direct to the air pump plunger, which being hollow, the main connecting rod is connected from the crank-pin to the bottom of the large end of it, in the same manner that the connecting rod of a trunk engine is connected to its trunk.

The small end of the plunger, which works through the back end of the pump, serves no other purpose than that of a guide, which becomes necessary as the main connexion of the engine is attached to this plunger. By this arrangement it will be seen, that the air-pump plunger has the same stroke as the steam piston, and makes the same number of strokes for any unit of time, which gives it a higher velocity than is usual or desirable in marine engines; but the engineer of this steamer informed me that he discovered no difficulty in the working of the pumps up to the maximum speed of the engines, viz: 62 revolutions per minute, the foot and inboard delivery valves consisting of a series of small circular india rubber valves, six inches in diameter by half an inch thick. The air-pump and condenser are cast in one piece, the condenser consisting of a rectangular box, fitted with a large number of man-holes for the purpose of clearing out the core at the time of casting, with the pump inside. The ends of the condensers are faced and bolted together; and the whole plan thus forms a more compact and substantial arrangement than any other type of propeller engines I have seen.

The only objection that I can notice to it as far as the engines are concerned, is the exceedingly high temperature of the engine room, which necessarily ensues from the fact of its being directly over the cylinders; but in this instance, much of the heat is avoided by a judicious arrangement of wind sails. Her propeller consists of a three bladed true screw, 14 feet 6 inches in diameter by 28 feet pitch, overhung, *i. e.*, the shaft has no bearing in the outer stern post.

She has four tubular boilers; two in one shell, with furnaces at each end, differing only from those of most of the English steamers in these waters by being set end to end in a fore and aft direction in the centre of the ship, instead of side by side athwartships. The coal bunkers are on either side of the boilers, and so arranged that the coal runs down of its own gravity to the furnace doors, avoiding the necessity of trimming it; but notwithstanding this advantage, they have employed on board that vessel forty-eight firemen and coal-heavers, more than the United States Steam Frigate *Powhatan* is allowed, a ship of 2500 tons burden. No one, I suppose, who has given the subject any attention, and whose opinion is worth obtaining, will deny that the engine department of the steamers of our navy are insufficiently manned, or if there be such a one, I would recommend him to take a cruise in the China Seas in one of our first class steam Frigates, during which I am very much inclined to think

he will collect sufficient evidence to occasion quite a change to come over the spirit of his dream. Any merchant steamer on this station is proportionally better manned in the engine department than the "*Powhatan*," and but few of them do more running. But I am digressing. I sat down to write about the "*Lancefield*."

To resume. The cylinders are fitted each with a locomotive slide valve, which cut off the steam at one-third from the termination of the stroke. They were formerly fitted also with slide cut-off valves, but they did not work well, and the engineer has now dispensed with them as a useless appendage, preferring the use of the throttle valve and the consequent loss of steam by wire drawing, when a reduction of speed becomes necessary.

With the maximum speed of 62 revolutions per minute, in smooth water, under steam alone, I am informed she obtains a speed of fifteen knots the hour; but as this only gives the propeller, allowing 6082⅔ feet to the knot, 12·3 per cent. slip, I fancy she does not make as much as that; but as she is a vessel of excellent model, very fine lines, and considerable length, comparatively with breadth of beam, I think that under favorable circumstances, her bottom and propeller blades being free from barnacles, shells, &c., that very rapidly form on iron vessels running in salt water, 20 per cent. would be a fair allowance for slip, which would give her a maximum speed of 13·7 knots per hour. This speed is obtained by the consumption of 45 tons of coal per diem. The data that I obtained relative to the performances of the boilers, &c., I do not consider sufficient of reliance upon which to base any calculations either of their evaporative powers, or the horses power developed by the engines, more particularly as I am in possession of no indicator diagrams showing the true point of cutting-off with the pressure of steam on the piston for any particular period. K.

For the Journal of the Franklin Institute.

Is there Native Iron in Africa? By Robert F. Brower, M. D., Secretary of the American Iron Association.

Not a little interest has been felt in relation to an alleged discovery of native iron in the interior of Africa. Nearly all our journals have published some general statements that have been made in respect to it, coupled with names of practical analysts; on which account we have waited with some hope that we should have, fully recorded, all the particulars of such an interesting and anomalous discovery. As we have not been satisfied by any explanations, we take the liberty to declare our opinion of the improbability of any such discovery, with the reasons for our conclusions. Inasmuch as we have had similar representations made concerning iron ores found in our own country, it is well that we should clearly understand how pure it is possible for iron to exist in its matrix —the soil or rocks.

Iron has a strong affinity for oxygen, to such an extent that it will decompose water, whether free or in union with soils or rocks. Most min-

erals contain water as a chemical constituent, and iron under the slow but sure operation of attraction will, where there is the least permeability of rocks, decompose it, drawing from it, even though at remote distance, its oxygen. Those elements which have the strongest affinities for each other, will unite when brought together, however long time is required. Whether we find iron in plutonic or secondary rocks, at whatever depth below the surface, it is invariably in the state of an oxide, if not combined with other elements. Such has been the universal experience of mining. Meteoric iron having been formed under different circumstances from any that present to us in or upon the earth, we cannot refer to it as conflicting with our statements.

Iron presents such a variety of interesting phenomena under various treatments, that it is very easy to be misled in theoretical conclusions, if we do not measure accurately the chemical forces at work. A smith may take a piece of the magnetic ore of Lake Champlain or New Jersey, or of the specular ore of Superior or Missouri, and by careful treatment in his smithery fire, will work out a knife blade from one end, while the other retains its original appearance. Again, he may take a piece of these ores, and in a moderate fire, allowing considerable time, will convert it into metallic iron, without altering materially its general outward appearance. That the smith and many others should conclude, therefore, that the ore was pure iron, is not at all strange. He does not know the influences of heat in driving off, or rather drawing off, its oxygen, to unite with a portion of the carbon of the fuel.

Iron under careful or moderate protection by artificial means may be preserved possibly for ages; but as a general rule it is steadily in process of union with oxygen and returns to earth. It is not reasonable, therefore, to expect to find virgin or native iron, unless it has been formed by some recent cause. Meteorolites are presumed to be ejected from volcanoes of our own or some other sphere. The only other conceivable circumstance under which pure iron might be formed in nature, is by the ejection of trap rock through pure iron ore lying contiguous to coal; but the great improbability of any such occurrence is at once evident to a geologist. The idea of such a possibility would not suggest itself, were it not stated that the alleged native iron was associated with zeolite. A crystallization often occurs in working iron ores which resembles zeolite, and possibly has the same composition. There are no facts presented in relation to the alleged native iron, disproving that the specimen was originally magnetic or specular oxide, or the spathic carbonate of iron, and had been converted in a smithery, under a slow fire, by which means, as it may often occur, there was no excess of carbon; on the contrary, crystals of magnetic oxide remained, with quartz and zeolite, a silicate of alumina, and lime or soda.

The following are the compositions of magnetic, specular, and spathic ores, which are the purest states in which iron is formed in the earth.

Magnetic iron ore ($Fe_3\ O_4$) contains in 100 parts

of iron, 72·4 parts by weight,
oxygen, 27·6 do. do.

affording 72·4 per cent. of iron by analysis, or about 65 per cent. in a smithery, or catalan forge fire, when carefully managed.

Specular iron ore (Fe_2 O_3) contains in 100 parts
of iron, 70 parts by weight,
oxygen, 30 do. do.
affording 70 per cent. of iron by analysis, or about 63 per cent. in a smithery, or catalan forge fire.

Spathic iron ore (Fe. O. C. O_2) contains in 100 parts
of iron, 48·3 parts of iron,
carbon, 10·4 do. do.
oxygen, 41·3 do. do.
affording 48·3 per cent. of iron by analysis, or about 40 per cent. in a smithery, or catalan forge fire.

We should remark in respect to this last ore, that when first mined it is yellow, but in time turns to a dark brown color. This ore when roasted becomes the magnetic oxide of iron, the carbonic acid being driven off or decomposed. When found quite pure, it may be worked as the others, in a smithery, or catalan forge fire. Most probably this is the ore found in Africa, for the Rev. Aaron P. Davis, who sent the specimens to America, writes that "When he (Mr. George L. Seymour, who obtained it from the natives) brought it, it appeared like a craggy rock, of yellowish color on its surface, and with a very small exception, it could not be separated but by heat, and hard pounding with my largest sledge hammer, and a chisel prepared for the purpose." *Heat and hard pounding*, we know not for how long a time, have materially altered the character of the mineral.

When pure iron ore in small quantities is reduced in a smithery fire, it may be worked to any degree of excellence. We have not space to show the relative costs of reduction by various processes, or to set forth the relative value of the products. But it is evident to every one conversant with the nature of iron, that in small quantities, in a charcoal fire, it may be thoroughly worked to a superior quality, as by the natives of Africa, at a heavy cost of labor. A SMALL SPECIMEN OF IRON PREPARED EXPRESSLY FOR ANY CERTAIN PURPOSE, DOES NOT AFFORD A PROPER EVIDENCE OF THE QUALITY WHICH CAN BE MADE FOR THE MARKET, WITHIN THE MARKET VALUE.

We cannot reasonably leave this subject without alluding to what would be the expense of mining native iron, supposing it were found. Even the quotation from Mr. Davis's letter may satisfy our judgment, though there is stronger evidence that it could not be mined at a profit for our market. Native copper when found in masses, costs for mining several times the value of its weight of iron. Copper may be cut with chisels, but who would undertake to cut up solid or even porous masses of iron for its whole value? If there are any who desire the business, they may find in our country pretty extensive masses of iron taken from chilled furnaces, which the furnace masters would gladly have removed from their premises.

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Since the above article was written, the writer has received specimens of the iron, and has examined several reports and accounts respecting the reputed discovery. He is fully confirmed in opinion that his views of the iron in question are correct; and that the specimens were "brought

to nature" in a smithery fire, from the spathic ore—the proto-carbonate of iron.

If there is an abundance of this ore, or of the others mentioned, in even a moderate degree of purity, found in Africa, and easy of access, it is far more valuable than a seam or deposit of massive native iron. Copper, in masses, may be cut up, and is then worth about $500 a ton. Crude irregular masses of iron would be worth not more than 20 to 25 dollars a ton.

An Account of some Experiments made with the Submarine Cable of the Mediterranean Electric Telegraph. By CHARLES WHEATSTONE, F.R.S.*

The following results were obtained between May 24 and June 8 in last year, with the telegraphic cable manufactured by Messrs. Kuper and Co. of East Greenwich, for the purpose of being laid across the Mediterranean Sea, from Spezia on the coast of Italy, to the island of Corsica. The manufacturers, in conjunction with Mr. Thompson, the engineer of the undertaking, kindly afforded me every facility in carrying on the experiments. The short time that elapsed between the opportunity presenting itself and the shipping of the cable for its destination, prevented me from determining with sufficient accuracy some points of importance, respecting which I was only able to make preliminary experiments, but the following, which I was able to effect with the means at hand, may possess sufficient interest to be made public. They present perhaps nothing theoretically new, but I am not aware that experimental verifications of some of these points have been made before. I assume that the reader is acquainted with the experiments of Dr. Faraday described in the *Philosophical Magazine*, Ser. 4, vol. vii, p. 197.

The cable was 110 miles in length, and contained six copper wires, one-sixteenth of an inch in diameter, each separately insulated in a covering of gutta percha one-tenth of an inch in thickness. The whole was surrounded by twelve thick iron wires twisted spirally around it, forming a complete metallic envelope one-third of an inch in thickness. A section of the cable presented the six wires arranged in a circle of half an inch diameter, and one-fifth of an inch from the internal surface of the iron envelope.

The cable was coiled in a dry well in the yard, and one of its ends was brought into the manufactory. The wires were numbered 1, 2, 3, 4, 5, 6, and the ends in the well were indicated by an accent; the ends 1′2, 2′3, 3′4, 4′5, 5′6 were connected by supplementary wires, so that the electric current might be passed in the same direction through all the six wires joined to a single length, or through any lesser number of them, the connexions being made at pleasure in the experimenting room.

The rheomotor employed was an insulated voltaic battery consisting of twelve troughs, each of twelve elements, which had been several weeks in action.

First Series.—The following experiments show that the iron envelope

* From the Lond., Edin., and Dub. Philos. Mag., July, 1855.

of the compound conductor gives rise to the same phenomena of induction which occur when the insulated wire is immersed in water, as in Dr. Faraday's experiments.

Exp. 1. One end of the entire length, 660 miles, was brought in connexion with one of the poles of the battery, the other end remaining insulated. The wire became charged with negative electricity when its end touched the zinc pole, and with positive electricity when it communicated with the copper pole. A current, indicated by a galvanometer placed near the battery, existed as long as the charge was going on, and ceased when it arrived at its maximum. [The feeble current attributed to imperfect insulation, which continues as long as the contact with the battery remains, is here left out of consideration.] When the wire was charged, and the discharge effected by a wire communicating with the earth, the current produced was in the same direction, whether the discharge was made near the battery or at the opposite end; *i. e.*, the current in both cases proceeded from the wire to the earth in the same direction.

Exp. 2. On bringing one end of the wire in contact with one of the poles of the battery, the other pole having no communication with the earth, the wire remained uncharged. A very slight and scarcely perceptible tremor was observed in the galvanometer needle interposed between the battery and the wire.

Exp. 3. To each of the poles of the battery was attached a wire 220 miles in length, and similar galvanometers were interposed between the two wires (the remote extremities of which remained insulated) and the battery. So long as one wire alone was connected with the battery no charge was communicated to it, but on connecting the other wire with the opposite pole both wires were instantaneously charged, as the strong deflection of both needles rendered evident. On bringing the free end of one of the wires in communication with the earth, it alone was discharged, the other wire remaining fully charged.

Second Series.—Exp. 4. One pole of the battery was connected with the earth, and the other with 660 miles of wire, which had an earth communication at its opposite end; three galvanometers were interposed in the course of the conductor; the first near the battery, the second in the middle of the wire, *i. e.*, 330 miles from each extremity, and the third at the remote end near the communication with the earth. When the connexion of the battery with the wire was completed, the galvanometers were successively acted upon in the order of their distances from the battery, as in the experiments recorded by Dr. Faraday. When the earth connexion at the remote extremity of the wire, on the contrary, was completed, the disturbance of equilibrium commenced at this end, and the galvanometers successively acted in the reverse order, *i. e.*, the galvanometer which was the most distant from the battery was the first impelled into motion. In the latter case, before the completion of the circuit, the needles of the galvanometers had assumed constant deflections to a limited extent, owing to a feeble current arising from the uniform dispersion of the static electricity along the wire.

Exp. 5. The two extremities of the 660 miles of wire were brought into connexion with the opposite poles of the battery. When one of the ends previously disconnected from the battery was united therewith, the

galvanometers at the extremities of the wire, and consequently which were at equal distances from the poles of the battery, were immediately and simultaneously acted upon, while that which was in the middle of the wire was subsequently caused to move. When the wire disconnected in the middle instead of near one of the poles of the battery was again united, the middle galvanometer, which was the most remote from the battery, was the first acted upon, and those near the poles subsequently.

The comparison of the two above mentioned experiments shows that the earth must not be regarded simply as a conductor, which many suppose to be the case. Since, in the first experiment there were not many yards distance between the two earth terminations, did the extent of ground between them act only as a conductor, the two galvanometers at the extremities of the wire should have acted simultaneously, as in the second experiment, and as would have been the case had a short wire united the two extremities which proceeded to the earth.

Third Series.—Exp. 6. One pole of the battery was connected with the earth, and the opposite pole with one extremity of the 660 miles of wire, the other end remaining insulated; a delicate galvanometer was interposed near the battery. Notwithstanding there was no circuit formed, the needle showed a constant deflection of 33½°; the feeble current thus rendered evident is not so much to be attributed to imperfect insulation, as to the uniform and continual dispersion of the static electricity with which the wire is charged throughout its entire length, in the same manner as would take place in any other charged body placed in an insulating medium. The strength of the current thus occasioned appears to be nearly, if not exactly, proportional to the length of the wire added, as the following table will show: the first column indicates the number of miles of wire subjoined beyond the galvanometer, and the second the corresponding deflections of the needle:—

Miles.	°	Miles.	°
0	0	330	18
110	6½	440	23½
220	12	550	28
		660	31

Exp. 7. One end of the 660 miles of wire was now allowed to remain constantly in contact with one of the poles of the battery; but the galvanometer was successively shifted to different distances from the battery. The strength of the current was now shown to be inversely as the distance of the galvanometer from the battery, becoming null at its extremity, as shown in the following table. The first column shows the distance from the battery at which the galvanometer was placed, and the second column the corresponding deflection of the needle.

Miles.	°	Miles.	°
Near the battery	33½	330	15
110	31	440	12
220	25	550	5
		660	0

The deflections of the needle of the galvanometer employed in these experiments were, when they did not surpass 36°, very nearly compara-

ble with the force of the current. This I ascertained in the following way. I took six cells of the small constant battery described in my paper "On new Instruments and Processes for determining the Constants of a Voltaic Circuit," printed in the Philosophical Transactions for 1843, and placed in the circuit formed of the 660 miles of wire, the earth, and the galvanometer, successively 1, 2, 3, 4, 5, and 6 cells. Leaving out of consideration the resistances in the cells themselves and in the earth, which were very inconsiderable in comparison with that in the long wire, the force of the current should be approximately proportionate to the number of the elements; and since the deflections of the needle nearly indicated this proportionality, as the following table will show, it may be assumed that the force of the current, when the deflection of the needle did not surpass 36°, nearly corresponded with the angular deviation.

Cell.	°	Cell.	°
1	6	4	28
2	14	5	32
3	19	6	36

From the preceding experiments (6 and 7,) it seems to result, that whatever length of wire is connected with the battery, if a galvanometer is placed at the farther extremity of the wire and a constant length added to the other termination of the galvanometer, its indication remains always nearly the same. Thus the galvanometer indicated $6\frac{1}{2}°$ when it was placed close to the battery and 110 miles of wire were subjoined beyond it; and 5° when 550 miles were interposed between the battery and galvanometer, the same length, 110 miles, being subjoined. In like manner, when 220 miles were added beyond the galvanometer placed near the battery, the indication was 12°; precisely the same as when 440 miles were interposed and 220 added. So also when 330 miles were added, the deviation of the galvanometer was 18°; and 15° when 330 miles were interposed and 330 added. I have no doubt that the correspondence would have been closer had it not been for the fluctuations of the battery.

It would appear from this, that whatever be the length of wire attached to the insulated pole of a battery, it becomes charged to the same degree of tension throughout its entire extent; so that another insulated wire brought into connexion with its free extremity exhibits precisely the same phenomena, in kind and measure, as when it is brought into immediate connexion with a pole of the battery. Some important practical consequences flow from this conclusion, which I will not develop at present, as I have not yet had an opportunity of submitting them to the test of experiment.

The Strength of Screw Blades; and an Instrument for measuring the Pitch and proving the correct Form of Screw-Propellers, called a Pitch Compass. By JAMES SPENCE, Chief Foreman of the Steam Factory of H. M. Dockyard, Portsmouth.*

The author stated that the form, length, diameter, and area of the *screw* had all been carefully examined and experimented on, and well authenticated data recorded; but he was not aware that so much attention had

*From the Lond. Civ. Eng., and Arch. Journal, August, 1855.

been paid to the strength of the *screw blade*. Hence we are frequently hearing of accidents from breakage. The author remarks that in all the broken screws they have had in the navy, the fractures have taken place at about one-third of the length of the blade from the boss. The boomerang of the *Duke of Wellington*, the *Phœnix*, and *Sir Thomas Mitchell*, all broke at about this point. Hence the peculiar converse form of the blade should be carried well out, beyond one-third of the length of the blade. The author then went on to describe a very useful instrument called a pitch compass, for measuring the pitch and proving the correctness of the form of screw-propellers. This machine was suggested by Mr. Rawson, head-master of the School of Shipwright Apprentices at the Dockyard. A chuck provides a centre pivot in the exact line of the axis of the screw. A trammel, made in two pieces, for strength and convenience, is filled with two trap bushes, having holes made to fit on the centre spindle of the chuck. It therefore forms a correct movable base line, at right angles to the axis of the screw. The circular plate on the chuck is divided into twelfths of the circumference, that is, the holes in it are thirty degrees apart. The trammel being secured in one of these holes, a measurement is taken from the trammel, as the base line, to the screw blade by means of a movable pointed rod at right angles to the trammel, and capable of being moved along the trammel as the length of the blade increases. The trammel is then moved to the next hole in the circular plate of the chuck and secured, it having passed through thirty degrees. A second measurement is then taken from the trammel to the screw blade, when the difference in inches between the first and second measurement will be equal to the whole pitch in feet, and so on, so that by indicating the commencement and end of the measurement, by rings clamped on the movable pointed rod, and measuring the alternate distances between them in inches, we get the whole pitch of the screw in feet.

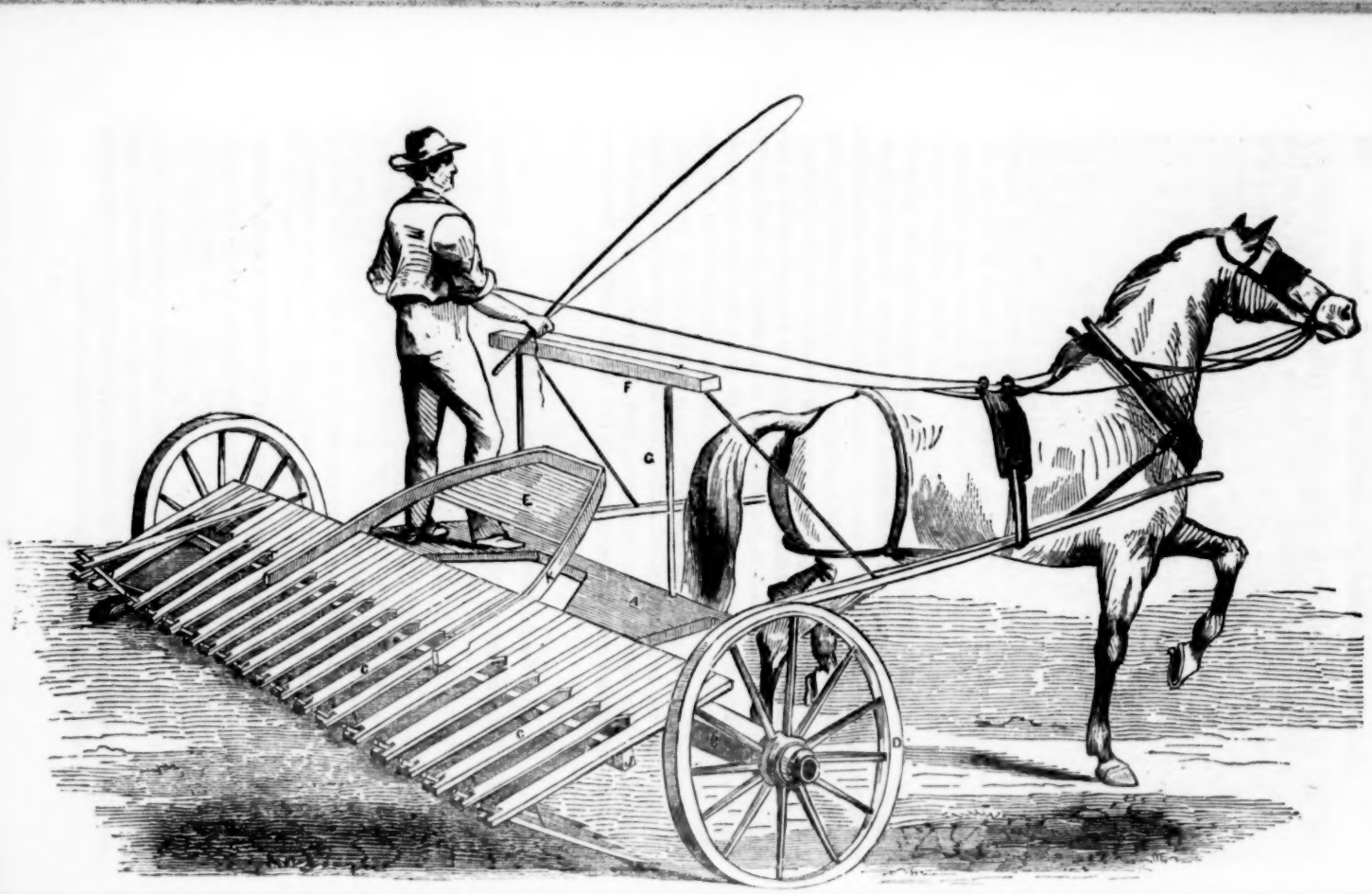
For the Journal of the Franklin Institute.

Mechanical Engineering as applied to Farm Implements. By H. Howson, Civ. Eng.

(Continued from page 343.)

That necessity is generally, if not always, the parent of invention, is exemplified by the introduction of the horse rake, as a labor saving adjunct of the mowing machine. To keep pace, indeed, by manual labor with the wonderfully rapid movements of the latter, would involve the necessity of employing more farm hands than American ingenuity could tolerate.

One of the indispensable requirements for the designer and builder of farm implements, is a thorough practical familiarity with the strength and durability of various descriptions of wood. It is no less necessary that he should be equally well veresd in the peculiar properties of cast and malleable iron and steel, and a still more important requisite for the completion of efficient agricultural machines is, that forethought and experience which may enable the manufacturer to combine these materials so as to develop their most important and useful qualities.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There are few if any contrivances for facilitating farm operations, which are not constructed of iron and wood combined, and the proper arrangement of these materials, consistent with strength, lightness, and durability, is the subject which should form the study of all who wish to excel in this important industrial feature of the age.

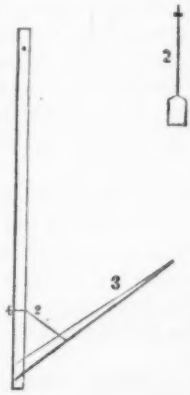
The duties to be performed by horse rakes are of such a nature, that the lightest materials may be used in their construction. We consequently find, that with the exception of a few iron rods and fastenings, these implements are generally made entirely of wood.

Of the several horse rakes now commonly used, and all of which are unexceptionable as regards their performance,

The Independent Tooth Rake of C. Delano, Patented in 1849,

appears to be one of the most complete, and as a popular machine, especially among the New England farmers, has been here selected for illustration.

In the annexed perspective view of this ingenious implement, A, is a platform secured to the shafts and to the axle tree B, the latter being furnished with light wheels D. To the axletree are secured several bolts with eyes about four inches above the axle, and through these eyes passes an iron rod about half an inch in diameter. C, are a series of wooden bars, about one inch and a quarter thick, five inches wide at the upper end, and two inches wide below. These bars are strung on to the half inch rod, in contact with each other at the top, so as to prevent any lateral movement, but independent of each other as regards vertical movement.



Into the ends of the rods C, are secured the teeth 3, the latter forming an angle of about fifty-six degrees with the former. Wire stays 2, (as seen in the annexed detached view) serve as additional security to the teeth. K, is a triangular wooden frame jointed to eyes on the axle B, between the latter and the rod to which the bars C, are strung. To the end of the frame K, is secured a cross bar J, about three inches by one inch in the centre and tapering towards the ends, the other end of the frame K, which projects about thirty inches in front of the axle, and is furnished with boards E, for the foot of the attendant.

A bar F, is erected on perpendicular rods C, and secured to the shafts by diagonal rods in front of the platform A, and serves as a guard for the driver. Should one of the teeth, as the machine is drawn over the ground, come in contact with a stone, sod, or other obstruction, it will rise from the ground without disturbing the neighboring teeth. When sufficient hay has been collected by the machine, the driver places one foot on the platform E, of the triangular frame K, and depressing the same, causes the cross bar J, to elevate the whole row of teeth, when the hay is released, after which the driver removes his foot and proceeds as before.

The price of Delano's horse rake is 22 dollars.

Allusion has been previously made to the multiplicity of churns patented and in common use throughout the Union. To give a succinct or even a passing account of the merits and features of such a host of these useful farm implements would occupy more space than the nature of these papers would allow. A perspective sketch of

Crowell's Patent Thermometer Churn, as Manufactured by Messrs. Landreth & Sons,

However, is here introduced as an instrument worthy of notice as well for its popularity as its ingenuity.

One of the features of this churn, is a double semicircular bottom of two sheets of zinc or other suitable material, placed one above the other, the cream resting on the uppermost. Between the two semicircular sheets is a space into which may be introduced cold or warm water, to increase or diminish the temperature of the cream above. Another feature in this churn is the application of a thermometer placed permanently at one end and entirely secured from breakage or other accident. This thermometer is marked at 62 degrees, at which temperature the cream may be maintained by pouring hot or cold water into the space between the two sheets of metal.

Inside the churn are two simple arms projecting from each end of, and at right angles to, the axis, and across the ends of these arms are secured the beaters.

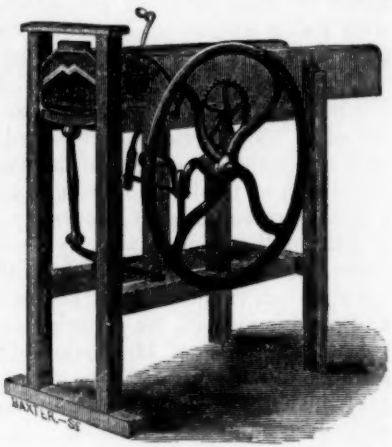
In operating the churn, the crank handle is turned at the rate of about forty revolutions per minute.

The above contrivance certainly possesses the advantage of enabling the operator to keep the cream definitely at the desired temperature without intermixing it with water or other substances. The price varies from $2·50 to $12.

Straw Cutter, Patented by C. W. Seeley of Albany, and Manufactured by Messrs. Landreth of this City.

The variety of straw and hay cutters is little short that of churns. Among the latest of the inventions and new contrivances for this purpose is one patented by C. W. Seeley of Albany, and manufactured by Messrs. Landreth of this City. This straw cutter, represented in the annexed perspective sketch, consists of a frame three feet high and one foot wide, supporting a box to hold the straw to be cut, the box being three and a half feet long, five inches deep, thirteen inches wide at one end, and eight inches at the other. At the narrow end are a pair of fluted

rollers driven by ratchets and pinions moved by a crank on the fly wheel shaft under the box. The fly wheel is of iron, two and a half feet across, and with a rim one inch and a quarter in diameter, and weighing about forty pounds, and is driven by a spur wheel about eight inches across on the end of the shaft, to which the driving handle is secured; the latter is thirteen inches long and is on the right hand side of the box, the fly wheel being on the left. From the fly wheel crank a rod eight inches long extends down to a lever sixteen inches long and hung to the lower part of the frame. From the other end of this lever another rod extends up to the knife frame, which is of cast iron, and supports a knife of the shape illustrated in the annexed cut.



As the handle is turned, the straw or corn stalks are drawn forward by the rollers and held over a square iron edge, when the knife comes down with a shearing cut and with power enough to cut the thickest corn stalk in two.

The point in the middle of the knife is the great feature of the improvement. The straw becoming crowded in a compact mass, by using a common inclined knife without this point is apt to cut hard. By using a knife of the above shape, however, the point begins to enter and cut with but little effort at the precise spot where, without it, the machine would require the greatest power to make the cut. There is another advantage in this knife. The point is so strong and the momentum so great, that a seasoned root or stock would be split and cut in two without checking the machine.

The retail price of this efficient instrument is twelve dollars.

(To be Continued.)

TWENTY-FIFTH MEETING OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

An Account of some Experiments with a Large Electro-Magnet. By Mr. JOULE.—Prof. W. THOMSON, in Mr. Joule's absence, brought the subject before the Section.—The relation of the exciting force to the sustaining power of a magnet was the subject which it was the author's desire to examine, the laws arrived at being very divergent from those usually received. The soft iron made use of in this magnet, was of such a nature that it always—probably on account of intense magnetization on some former occasion—retained a residual polarity which was always in the same direction. The magnet might be excited by a current which

*From the Lond. Athenæum, September, 1855.

developed a polarity opposed to the residual one; but, on the interruption of the current, the latter re-appeared. With high power, the lifting power fell short of being proportional to the square of the current; but with feeble excitation, Mr. Joule found the sustaining force to vary as the fourth or fifth power of the current strength employed.

Dr. Robinson gave an account of some of his own experiments on this subject, which confirmed those of Mr. Joule. The magnet made use of in his experiments consisted of two upright pillars of soft iron, with a movable crosspiece of thesame metal, which enabled him to vary the length of the limbs of the magnet. To determine the lifting power, a keeper, or sub-magnet, accurately planed, was placed across from pole to pole of the magnet, and, by a suitable mechanical arrangement, the force necessary to separate it from the excited magnet was determined. An approach to the point of magnetic saturation soon manifested itself, and, in this respect, the experiments of Prof. Robinson were quite confirmatory of those of Mr. Joule.—Prof. Tyndall remarked that he had sometimes been surprised to observe the comparatively low power of excitement in Mr. Joule's experiments at which the approach to magnetic saturation was exhibited. In Müller's experiments, where thick bars of iron were used, it required very strong excitation to produce the falling off, from the law that the magnetic attraction is proportional to the square of the exciting current. In Mr. Joule's experiments masses of soft iron were made use of, of far greater size than those used by Müller, but nevertheless the falling off from the law alluded to soon exhibited itself. In the remarks which had been brought before the Section, the shape of the magnet was omitted as an element in the question; but in all probability, it would be found that if one of the limbs of Dr. Robinson's magnet were employed alone as a straight bar, its magnetism being measured by its action upon a freely suspended magnetic needle, instead of by its lifting power, the magnetic saturation of the bar would be much more difficult of attainment. Or even preserving the form of experiment made use of by Dr. Robinson, and introducing a plate of non-magnetic matter one-tenth or one-hundredth of an inch in thickness between the keeper and the magnet, a totally different law of lifting power would be obtained; the magnetic attraction in the last case would preserve its proportionality with the square of the current for a much longer period. A current which would appear to saturate the magnet in Dr. Robinson's experiments would not saturate in the latter case; and there does not appear to be any sufficient reason for accepting the latter result in preference to the former as expressive of the absolute capacity of the magnet for magnetization.—Dr. Robinson observed in reply, that he believed his method of experiment preferable to that suggested by Prof. Tyndall for the special object in view. He regarded the disruption of direct contact better calculated to throw light on the true state of the magnet than the separation of the keeper where an interval existed between it and the magnet. He had actually introduced such an interval as that spoken of by Prof. Tyndall, and it was true that he had found a totally different law from that arrived at when magnet and sub-magnet were in contact.

On Peristaltic Induction of Electric Currents in Submarine Telegraph Wires. By Prof. THOMSON.—Recent examinations of the propagation of electricity through wires in subaqueous and subterranean telegraph cables, have led to the observation of phenomena of induced electric currents, which are essentially different from the phenomena (discovered by Faraday many years ago) of what has hitherto been called electro-dynamic, or electro-magnetic induction, but which, for the future, it will be convenient to designate exclusively by the term electro-magnetic. The new phenomena present a very perfect analogy with the mutual influences of a number of elastic tubes, bound together laterally throughout their lengths, and surrounded and filled with a liquid which is forced through one or more of them, while the others are left with their ends open or closed. The hydrostatic pressure applied to force the liquid through any of the tubes will cause them to swell, and to press against the others, which will thus, by peristaltic action, compel the liquid contained in them to move in different parts of them in one direction or the other. A long solid cylinder of India-rubber, bored symmetrically in four, six, or more circular passages parallel to its length, will correspond to an ordinary telegraphic cable containing the same number of copper wires, separated from one another only by gutta percha; and the hydraulic motion will follow rigorously the same laws as the electrical conduction, and will be expressed by identical language in mathematics, provided the lateral dimensions of the bores are so small, in comparison with their lengths, or the viscocity of the fluid so great, that the motions are not sensibly affected by inertia, and are consequently dependent altogether on hydrostatic pressure and fluid friction. Hence the author considers himself justified in calling the kind of electric action now alluded to, *peristaltic induction*, to distinguish it from the electro-magnetic kind of electro-dynamic induction. The mathematical treatment of the problem of mutual peristaltic induction is contained in the paper brought before the Section; but the author confined himself in the meeting to mentioning some of the results. Among others, he mentioned, as being of practical importance, that the experiments which have been made on the transmission of currents backwards and forwards by the different wires of a multiple cable, do not indicate correctly the degree of retardation that is to be expected when signals are to be transmitted through the same amount of wire laid out in a cable of the full length. It follows, that expectations as to the working of a submarine telegraph between Britain and America, founded on such experiments, may prove fallacious; and to avoid the chance of prodigious losses in such an undertaking, the author suggested that the working of the Varna and Balaklava wire should be examined. He remarked that a part of the theory communicated by himself to the Royal Society last May, and published in the Proceedings, shows that a wire of six times the length of the Varna and Balaklava wire, if of the same lateral dimensions, would give thirty-six times the retardation, and thirty-six times the slowness of action. If the distinctness of utterance and rapidity of action practicable with the Varna and Balaklava wire are only such as to be not inconvenient, it would be necessary to have a wire of six times the diameter; or better, thirty-six wires of the same dimensions; or a larger number of still

smaller wires twisted together, under a gutta percha covering, to give tolerably convenient action by a submarine cable of six times the length. The theory shows how, from careful observations on such a wire as that between Varna and Balaklava, an exact estimate of the lateral dimensions required for greater distances, or sufficient for smaller distances, may be made. Immense economy may be practised in attending to these indications of theory in all submarine cables constructed in future for short distances; and the non-failure of great undertakings can alone be *insured* by using them in a preliminary estimate.

Experimental Observations on an Electric Cable. By Mr. WILDMAN WHITEHOUSE.—After referring to the rapid progress in submarine telegraphy which the last four years have witnessed, Mr. Whitehouse said that he regarded it as an established fact that the nautical and engineering difficulties which at first existed had been already overcome, and that the experience gained in submerging the shorter lengths, had enabled the projectors to provide for all contingencies affecting the greater. The author then drew the attention of the Section to a series of experimental observations which he had recently made upon the Mediterranean and Newfoundland cables, before they sailed for their respective destinations. These cables contained an aggregate of 1125 miles of insulated electric wire,—and the experiments were conducted chiefly with reference to the problem of the practicability of establishing electric communications with India, Australia, and America. The results of all the experiments were recorded by a steel style upon electro-chemical paper by the action of the current itself, while the paper was, at the same time, divided into seconds and fractional parts of a second by the use of a pendulum. This mode of operating admits of great delicacy in the determination of the results, as the seconds can afterwards be divided into hundreds by the use of a "vernier," and the result read off with the same facility as a barometric observation. Enlarged fac-similes of the electric autographs, as the author calls them, were exhibited as diagrams, and the actual slips of electro-chemical paper were laid upon the table. The well known effects of induction upon the current were accurately displayed; and contrasted with these were other autographs, showing the effect of forcibly discharging the wire by giving it an adequate charge of the opposite electricity in the mode proposed by the author. No less than eight currents—four positive and four negative—were in this way transmitted in a single second of time through the same length of wire (1125 miles) through which a single current required a second and a half to discharge itself *spontaneously* upon the paper. Having stated the precautions adopted to guard against error in the observations, the details of the experiments were then concisely given, including those for "velocity," which showed a much higher rate attainable by the magneto-electric than by the voltaic current. The author then recapitulated the facts, to which he specially invited attention:—First, the mode of testing velocity by the use of a voltaic current divided into two parts (a split current), one of which shall pass through a graduated resistance tube of distilled water, and a few feet only of wire, while the other part shall be sent through the long circuit, both being made to record themselves by adjacent styles upon the same slip of electro-chemical paper. Second, the use of mag-

neto-electric "twin currents," synchronous in their origin, but wholly distinct in their metallic circuits, for the same purpose, whether they be made to record themselves direct upon the paper, or to actuate relays or receiving instruments which shall give contacts for a local printing battery. Third, the effects of induction, retardation of the current, and charging of the wire, as shown autographically; and contrasted with this—fourth, the rapid and forcible discharging of the wire by the use of an opposite current; and hence—fifth, the use of this as a means of maintaining, or restoring at pleasure, the electric equilibrium of the wire. Sixth, absolute neutralization of currents by too rapid reversal. Seventh, comparison of working speed attainable in a given length of wire by the use of repetitions of similar voltaic currents as contrasted with alternating magneto-electric currents, and which, at the lowest estimate, seemed to be seven or eight to one in favor of the latter. Eighth, proof of the co-existence of several waves of electric force of opposite character in a wire of given length, of which each respectively will arrive at its destination without interference. Ninth, the velocity, or rather amount of retardation, greatly influenced by the energy of the current employed, other conditions remaining the same. Tenth, no adequate advantages obtained in a 300-mile length by doubling or trebling the mass of conducting metals. The author, in conclusion, stated his conviction that it appeared from these experiments, as well as from trials which he had made with an instrument of the simplest form, actuated by magneto-electric currents, that the working speed attainable in a submarine wire of 1125 miles was ample for commercial success. And may we not, he added, fairly conclude also that India, Australia, and America, are accessible by telegraph without the use of wires larger than those commonly employed in submarine cables?

Note on Solar Refraction. By Prof. Piazzi Smyth.—Amongst other interesting and important consequences of the dynamical theory of heat, Prof. W. Thomson having deduced the necessity of a resisting medium, the condensation of this about the sun, and a consequent refraction of the stars seen in that neighbourhood. Prof. Piazzi Smyth had endeavored to ascertain by direct astronomical observation, whether any such effect was sensible to our best instruments. Owing to atmospheric obstructions, only three observations, yielding two results, had been yet obtained; but both these indicated a sensible amount of solar refraction. Should this effect be confirmed by more numerous observations, it must have important bearings on every branch of astronomy; and as the atmosphere at all ordinary observatories presents almost insuperable obstacles, the author pointed out the advantage of stationing a telescope for this purpose on the summit of a high mountain.

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Remarks on the Chronology of the Formations of the Moon. By Prof. Nichol.—Prof. Nichol stated that, through the munificence of the Marquis of Breadalbane, he had been enabled to bring to bear on the delicate inquiries, whose commencement he intended to explain, a very great, if not a fully adequate, amount of telescopic power. A speculum of twenty-one inches, originally made by the late Mr. Ramage with the impracticable focal length of *fifty-five feet*, had, at the expense of that noble Lord, been re-ground, polished, mounted as an equatorial, and placed

in the Glasgow Observatory, in its best state, only about six weeks ago. Prof. Nichol showed some lunar photographs, which indicated the great light with which the telescope endowed its focal images, and entered on other details as to its *definition*. The object of the present paper is the reverse of speculative. It aims to recall from mere speculation, to the road towards positive inquiry, all observers of the lunar surface. To our satellite hitherto those very ideas have been applied, which confused the whole early epochs of our terrestrial geology, the notion, viz: that its surface is a *chaos*, the result of primary, sudden, short-lived, and lawless convulsion. We do not now connect the conception of irregularity with the history of the earth:—it is the triumph of science to have analyzed that apparent chaos, and discerned order through it all. The mode by which this has been accomplished, it is well known, has been the arrangement of our terrene mountains according to their relation to time: their relative ages determined, the course of our world seemed smooth and harmonious, like the advance of any other great organization. Ought we not then to attempt to apply a similar mode of classification to the formations in the moon,—hoping to discern there also a course of development, and no confusion or manifestation of irregular convulsion? Prof. Nichol then attempted to point out that there appeared a practical and positive mode by which such classification might be effected. It could not, in so far as he yet had discerned, be accomplished by tracing, as we had done on earth, relations between lunar upheavals and stratified rocks; but another principle was quite as decisive in the information it gave, viz: the intersection of dislocations. There are clear marks of dislocation in the moon—nay, the surface of our satellite is overspread with them. These are the rays of light, or rather bright rays, that flow from almost all the great craters as their centres, and are also found where craters do not at present appear. Whatever the substance of this highly reflecting matter, it is evidently no superficial layer or stream, like lava, but extends downwards a considerable depth into the body of the moon. In short, we have no likeness to it on earth, in the sense now spoken of, except our great trap and crystalline *dykes*. It seemed clear, then, that the intersection of these rays are really *intersections of dislocations*, from which we might deduce their chronology. Can the intersection, however, be sufficiently seen?—In other words, is the telescope adequate to determine which of the two intersecting lines has disturbed or cut through the other? Prof. Nichol maintained the affirmative in many cases, and by aid of diagrams, taken down from direct observation, illustrated and enforced his views.

On the Achromatism of a Double Object-Glass. By Prof. Stokes.—The general theory of the mode of rendering an object-glass achromatic, by combining a flint-glass with a crown-glass lens, is well known. The achromatism is never perfect, on account of the irrationality of dispersion. The defect thence arising cannot possibly be obviated except by altering the composition of the glass. It seemed worthy of consideration, whether much improvement might not be effected in this direction; but the problem which the author proposed for consideration was only the following:—Given the kinds of glass to be employed, to find what ought to be done so as to produce the best effect; in other words, to determine

the ratio of the focal lengths which gives the nearest approach to perfect achromatism. Two classes of methods may be employed for this purpose. In the one, compensations are effected, by trial, on a small scale; in the other, the refractive indices of each kind of glass are determined, for certain well defined objects in the spectrum, such, for example, as the principal fixed lines. The former has this advantage, that compensations on a small scale do not furnish so delicate a test as the performance of a large object-glass. The observation of refractive indices, on the other hand, admits of great precision; but it does not immediately appear what ought to be done with the refractive indices when they are obtained. After alluding to the method proposed by Fraunhofer for combining the refractive indices, which, however, as he himself remarked, did not lead to results in exact accordance with observation, the author proposed the following as the condition of nearest approach to achromatism:—that the point of the spectrum, for which the focal length of the combination is a minimum, shall be situated at the brightest part, namely, at about one-third of the interval D E from the fixed line D, towards E. The refractive index of the flint glass may be regarded as a function of the refractive index of the crown glass, and may be expressed with sufficient accuracy by a series with three terms only. The three arbitrary constants may be determined by the values of three refractive indices, determined for each kind of glass. On applying the resulting formula to calculate r, (the ratio of the chromatic changes of the indices of refraction,) for the object-glass, for which Fraunhofer has given both the refractive indices of the component glasses and the value of r, which, as observation showed, gave the best results, and taking in succession various combinations, of three lines each, out of the seven used by Fraunhofer, the author found that, whenever the combination was judiciously chosen, the resulting value of r was the same, whatever might have been the combination, and equal to 1·980, which is precisely the value determined by Fraunhofer, from observation, as giving the best effect.

On the Polar Decomposition of Water by Frictional and Atmospheric Electricity. By Prof. Andrews.—The author having drawn attention to the fact, that water had never been decomposed by the action of the common friction electricity, so as to collect the gases and exhibit them at the opposite poles, stated that the cause of the failure of the experiment was the solution of the gases in the mass of the liquid. By fusing platina wires in thermometer tubes, this difficulty is avoided, and the gases may be then obtained and collected with the same facility as in ordinary eudiometric experiments. By arranging a series of such tubes, the operations may be almost indefinitely repeated. On raising an electrical kite, the author succeeded in obtaining the polar decomposition of water by atmospheric electricity. The observations were made in fine weather, when the atmosphere was not usually charged with electricity. Although the gases were easily collected and measured, from the delicate form of apparatus employed, the quantity of water decomposed in this case amounted only to one 700,000th of a grain in the hour.

On the Phosphorescence and Composition of Plate-Sulphate of Potash. By Prof. Penny.—The subject of this paper is a chemical product from kelp. It is called plate-sulphate of potash from the circumstance of its

being crystallized in thick plates or slabs, consisting of the aggregate layers of successive crops of crystals. Beautiful specimens of the salt, supplied by Mr. Paterson, one of the most extensive manufacturers of kelp products in Glasgow, were exhibited to the Section. There are several points in the chemical history of this salt possessing a high degree of scientific interest. The principal points alluded to by the author of the paper were, first, the peculiarity of the process by which it is obtained in slabs or slates; second, the brilliant phosphorescence of its crystals at the time of their formation; and third, its remarkable composition. The mode of obtaining it was fully explained, and the various circumstances that influence the emission of light from the salt, at the time of crystallizing, were minutely described.

On a new Form of Cyanic Acid. By Baron Liebig.—In the course of some experiments on the fulminate of mercury, I observed that that compound, when kept boiling in water, changed its color, and lost its fulminating properties. On examining the change that had taken place in the composition of the fulminate, I discovered a new acid which had exactly the composition of cyanuric acid, but which differed entirely from that acid in its properties, and in the properties of the salts which are produced with the alkaline bases—salts remarkable for their beauty and for the distinctness of their crystalline form. Taking for the equivalent of hydrated fulminic acid the formula C^2, NO, HO, the new acid is produced in a very similar manner. The elements of three equivalents of fulminic acid unite to form one equivalent of the new acid, to which I shall give the name of fulminuric acid. This acid is monobasic. Its salt of silver is soluble in hot water, and crystallizes from it in long, silky, white needles. The alkaline salts of the new acid are very easily prepared by boiling the fulminate of mercury with an alkaline chloride. The fulminate of mercury is first dissolved; then gradually two-thirds of the oxide of mercury precipitates, and the alkaline fulminate, with a certain quantity of chloride of mercury and potassium, remains in the solution. By employing the chloride of sodium, or the chloride of barium, we obtain, of course, a salt of the new acid, with a base of soda or of barytes. With chloride of ammonium an ammoniacal salt is obtained, the crystals of which are distinguished from all others by their adamantine brilliancy, and their high degree of power and lustre. These crystals belong to the Klinerhombic system, and possess double refraction almost as strongly as Iceland spar. The hydrated acid is easily obtained by decomposing the basic lead salt by means of sulphuretted hydrogen. It has a strongly acid re-action, and when reduced by evaporation to a state of syrup, it is transformed by degrees into a crystalline mass, which dissolves in alcohol, and which, by the action of acids, is changed into carbonic acid and ammonia.

On the Extraction of Metals from the Ore of Platinum. By M. Fremy.—M. Frémy treated of the preparation of osmium, rhodium, and iridium, from the residues of the platinum ores. The preparation of osmium according to the old method is attended with great difficulties and actual danger. M. Frémy proposed to prepare osmium by passing atmospheric air over the residual ore, heated in a porcelain tube. The volatile osmic acid is condensed in glass balloons, and the less volatile oxide of ratheni-

um is found at the extremity of the heated tube. The rhodium remaining in the residual mass is separated from the other metal contained by chlorine gas at a high temperature.

On the Allotropic Modifications of Chlorine and Bromine analogous to the Ozone from Oxygen. By Prof. Andrews, who explained that ozone could be produced, first, by an electric spark; secondly, by the decomposition of acids and solutions, when coming into contact with the galvanic wire; and lastly, by oxidation.

On a Process for obtaining Lithographs by the Photographic Process. By Prof. Ramsey.—Prof. Ramsey described a process by which Mr. Robert M'Pherson, of Rome, had succeeded in obtaining beautiful photo-lithographs.—specimens of which had been hung up in the Photographic Exhibition in Buchanan Street. The steps of the process are as follows:—1. Bitumen is dissolved in sulphuric acid, and the solution is poured on an ordinary lithographic stone. The ether quickly evaporates, and leaves a thin coating of bitumen spread uniformly over the stone. This coating is sensitive to light, a discovery made originally by Mr. Niepce, of Chalons. 2. A negative on glass, or waxed paper, is applied to the sensitive coating of bitumen, and exposed to the full rays of the sun for a period longer or shorter according to the intensity of the light, and a faint impression on the bitumen is thus obtained. 3. The stone is now placed in a bath of sulphuric ether, which almost instantaneously dissolves the bitumen, which has not been acted upon by light, leaving a delicate picture on the stone, composed of bitumen on which the light has fallen. 4. The stone, after being carefully washed, may be at once placed in the hands of the lithographer, who is to treat it in the ordinary manner with gum and acid, after which proofs may be thrown off by the usual process.—Prof. Ramsey then proceeded to state that the above process, modified, had been employed with success to etch plates of steel or copper, without the use of the burin:—1. The metal plate is prepared with a coating of bitumen, precisely in the manner noticed above. 2. A positive picture on glass or paper is then applied to the bitumen, and an impression is obtained by exposure to light. 3. The plate is placed in a bath of ether, and the bitumen not acted upon by light is dissolved out. A beautiful negative remains on the plate. 4. The plate is now to be plunged into a galvano-plastic bath, and gilded. The gold adheres to the bare metal that refuses to attach itself to the bitumen. 5. The bitumen is now removed entirely by the action of spirits and gentle heat. The lines of the negative picture are now represented in bare steel or copper, the rest of the plate being covered by a coating of gold. 6. Nitric acid is now applied as in the common etching process. The acid attacks the lines of the picture formed by the bare metal, but will not bite into the gold surface. A perfect etching is thus obtained.

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*On Writing Inks.** By James Stark, M. D., F.R. S. E.

The author stated that in 1842, he had commenced a series of experiments on writing inks, and up to this date had manufactured 229 differ-

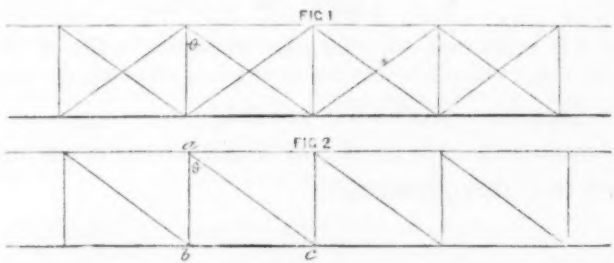
* From the Lond. Civ. Eng. and Arch. Jour., August, 1855.

ent inks, and tested the durability of writings made with these on all kinds of paper. As the result of his experiments, he showed that the browning and fading of inks, resulted from many causes, but in ordinary inks chiefly from the iron becoming peroxygenated, and separating as a heavy precipitate. Many inks, therefore, when fresh made, yielded durable writings; but when the ink became old, the tannogallate of iron separated, and the durability of the ink was destroyed. From a numerous series of experiments, the author showed that no salt of iron and no preparation of iron equalled the common sulphate of iron, that is, the commercial copperas, for the purposes of ink-making, and that even the addition of any persalt, such as the nitrate or chloride of iron, though it improved the present color of the ink, deteriorated its durability. The author failed to procure a persistent black ink, from manganese or other metal or metallic salt. The author exhibited a series of eighteen inks, which had either been made with metallic iron, or with which metallic iron had been immersed, and directed attention to the fact that, though the depth and body of color seemed to be deepened, yet in every case the durability of writings made with such ink was so impaired, that they become brown and faded in a few months. The most permanent ordinary inks, where shown to be composed of the best blue gall-nuts with copperas and gum, and the proportions found on experiment to yield the most persistent black, were six parts of best blue galls to four parts of copperas. Writings made with such an ink, stood exposure to sun and air for twelve months, without exhibiting any change of color, while those made with inks of every other proportion or composition, had more or less of their color discharged when similarly tested. This ink, therefore, if kept from moulding and depositing its tannogallate of iron, would afford writings perfectly durable. It was shown that no gall and logwood ink was equal to the pure gall ink, in so far as durability in the writings was concerned. All such inks lost their color and faded sooner than pure gall inks, and several inks were exhibited, which, though durable before the addition of logwood, faded rapidly after logwood was added to them. Sugar was shown to have an especially hurtful action on the durability of inks containing logwood—indeed on all inks. Many other plain inks were exhibited, and their proportions described—as gallo-sumach ink, myrobalans ink, Range's ink,—inks in which the tannogallate of iron was kept in solution by nitric, muriatic, sulphuric, and other acids, or by oxalade of potash, chloride of lime, &c. The myrobalans ink was recommended as an ink of some promise for durability, and as the cheapest ink it was possible to manufacture. All ordinary inks, however, were shown to have certain drawbacks, and the author endeavored to ascertain by experiment, whether other dark substances could be added to inks, to impart greater durability to writings made with them, and at the same time prevent those chemical changes which were the cause of ordinary inks fading. After experimenting with various substances, and, among others, with Prussian blue and indigo dissolved in various ways, he found the sulphate of indigo to fulfil all the required conditions; and, when added in the proper proportion to a tannogallate ink, it yielded an ink which is agreeable to write with, which flows freely from the pen, and does not clog it, which never moulds, which, when it dries on the paper, becomes

of an intense pure black, and which does not fade or change its color, however long kept. The author pointed out the proper proportions for securing these properties, and showed that the smallest quantity of the sulphate of indigo which could be used for this purpose, was eight ounces for every gallon of ink. The auther stated that the ink he preferred for his own use was composed of twelve ounces of galls, eight ounces of sulphate of indigo, eight ounces of copperas, a few cloves, and four or six ounces of gum-arabic, for a gallon of ink. It was shown that immersing iron wire or filings in these inks, destroyed their durability as much as similar treatment destroyed ordinary inks. He therefore recommended that *all legal deeds or documents should be written with quill pens*, as the contact of steel invariably destroys more or less the durability of every ink. The author concluded his Paper with a few remarks, on copying inks, and indelible inks, showing that a good copying ink has yet to be sought for, and that indelible inks, which will resist the pencilings and washings of the chemist, and the forger, need never be looked for.

In Openwork Girders, with Braces alternately Perpendicular and Oblique. To determine that value of the Angle θ (which the oblique braces make with a vertical line) that will produce the greatest economy in the weight or cost of the bracing. By R. H. Bow, Civ. Eng.*

Though we confine our attention in the following investigation to fig. 2, the results are equally applicable to fig. 1.



Let the weight (or cost, according as lightness or cheapness is sought after) of a unit of length of a perpendicular brace, capable of conveying a unit of strain, compressive or tensile as the case may be, ÷ The weight (or cost) of a unit of length of an oblique brace, capable of conveying a unit of strain, tensile, or compressive as the case may be, be=*n*

Let the length *ab* of a perpendicular brace = rad.= 1;

*From the Lond. Civ. Eng. and Arch's. Jour., September, 1855.

Then the length *ac* of an oblique brace will be $= \sec \theta$;

And the number of perpendicular, or of oblique braces in a given length, L, will be $= \frac{L}{bc} = \frac{L}{\tan \theta}$

The strains in the perpendicular braces, compared with the strains in the oblique braces, will be as rad.: sec θ; and the weights (or costs) will be as the lengths multiplied by the strains and by the allowance of metal (or cost) for each unit of strain; therefore,

The weight, or cost, of one oblique and of one perpendicular brace $\Big\}$ $\div \sec \theta \times \sec \theta \times 1 + r \times r \times n$

$$= \sec^2 \theta + n.$$

And multiplying this by $\frac{L}{\tan \theta}$, we get

The total weight, or cost, of the bracing for a length $= L$ $\Big\}$ $\div \frac{L \sec^2 \theta}{\tan \theta} + \frac{Ln}{\tan \theta} \div \frac{\sec^2 \theta}{\tan \theta} + \frac{n}{\tan \theta}$

$$= \frac{\sec \theta}{\sin \theta} + \frac{n}{\tan \theta}$$

which by the Calculus we find to be a minimum when

$$\tan \theta = \sqrt{1 + n}.$$

So that when $n = 0{\cdot}5$, then $\theta = 50^\circ\ 46'\frac{1}{2}$
" $n = 1{\cdot}0$, " $\theta = 54^\circ\ 44'$
" $n = 2{\cdot}0$, " $\theta = 60^\circ$

When n is made $= 0$, we get a case analogous to that of Warren's Bridge, in which oblique braces are alone taken into consideration:

Thus, $\tan \theta = \sqrt{1 + 0}$ $\therefore \theta = 45^\circ$,

the most economical angle for Warren or lattice forms of bracing.

7 *South Gray Street, Edinburgh.*

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*Utilization of Slag.**

Sir:—Mr. Mushet, in his letter last week, referred to my manufacture of artificial slag, in combination with other manufactures, by using the waste heat (so easily and generally applied) from a reverberatory furnace, for generating steam, &c.

As the ironmasters cannot be prevailed upon to use their slag, and it is not to be expected they will allow others to use their premises (even where the premises would admit), I am driven to the use of artificial slag, to show that we are not entirely dependent on them for an economical and abundant supply, which is practically proved (to some extent) by Messrs. Chance, of Birmingham, with the Rowley ragstone, melted in a

* From the Lond. Journal of the Society of Arts, July, 1855.

reverberatory furnace, as patented by Mr. Adcock, *subsequent* to my first patent for "clay and other plastic materials;" but as that material is confined to certain districts, similar to the ironstone, it is not likely to be generally used. By analysis it will be found that the common brick earths contain the elements of slag, namely, lime, silica, and alumina, and some of them have been taken direct from the pit to the furnace, and run into slag in less than two hours, without requiring any mixture, thereby proving that for general use, either on a *small or large* scale, there is no slag material equal to the common brick earths, which not only establishes the novelty of my first patent, but shows the applicability of the same to every locality, for the purpose of manufacturing numerous articles of unlimited demand; and as slag cannot be manufactured by any process without a loss of about 80 per cent. of heat, which may be applied (on a small scale) to generating steam for grinding corn, tempering, moulding, drying, and burning of common bricks, pipes, tiles, pottery, cement, &c., &c., or used in combination with any other manufacture requiring steam, by making one fire answer the purpose of several, and in many cases making a double use of the tall chimneys, kilns, furnaces, and other buildings now actually in operation in almost every country town in England. Having shown the capability of using the waste heat, I admit it is incumbent on me to show some process in addition to those now before the public, as published by Dr. Smith (*ante*, page 338), by which slag can be manufactured alone, at a profit; I, therefore, beg to submit the following calculations for public opinion and discussion:—

Slag as Compared with Slate.

Duchess slates, 24 inches by 12 inches, at £12 10s. per thousand, (the price of slate will vary in every locality.)

180 slates at 3d. per slate, $5\frac{1}{4}$ lbs. each—8cwt. 49 lb., worth £2 5s. =360 square feet of slag, $\frac{1}{2}$-inch thick, $6\frac{1}{4}$ lbs. per foot, 1 ton worth £2 5s.

360 slates at 3d. per slate, $5\frac{1}{4}$ lbs. each—16cwt. 98 lbs., worth £4 10s. =720 square feet of slag, $\frac{1}{2}$-inch thick, 3 lbs. per foot, 1 ton worth £4 10s.

720 slates at 3d. per slate, $5\frac{1}{4}$ lbs. each—1 ton 13cwt. 84 lbs., worth £9=1440 square feet of slag, $\frac{1}{3}$-inch thick, $1\frac{1}{2}$ lbs. per foot, 1 ton worth £9.

One reverberatory furnace will melt 5 tons of raw material in 24 hours, the cost of which cannot exceed the following estimate (on a small scale) suitable to every locality, (on a large scale the expenses in labour would be much less).

	£.	s.	d.
4 tons of coal, at £1 5s. per ton,	5	0	0
8 furnace-men and moulders,	2	0	0
4 packers in ovens,	1	0	0
8 boys,	0	16	0
2 overlookers,	1	0	0
Wear and tear, interest, rent, &c.,	0	15	0
6 tons of raw material (dug on the spot),	0	12	0
Cost of 24 hours in succession,	11	3	0
			3
Cost of 3 days and 3 nights,	33	9	0

			£. s. d.
Amount brought forward,			33 9 0
	Produce.	£. s. d.	
5 tons of manufactured ½-inch slabs		11 5 0	
5 tons ditto ¼-inch slabs,		22 10 0	
5 tons ditto ⅛-inch slabs,		45 0 0	
		£78 15 0	
Profit			45 6 0
			£78 15 0

Slag is particularly adapted for roofing similar to the Crystal Palace, and may be manufactured and used similar to rough glass, with putty and paint, and if so used, the above calculations may be nearly doubled, as they are upposed to be worked as slate. Thin slabs may also be used instead of plastering, as Dutch tile are frequently used, and will admit of papering or painting immediately, and will be found a certain remedy for damp and vermin.

If worked on a large scale, a small blast furnace may be used for melting, the material to be dried by the waste heat, but as it will then be mixed with the fuel in the furnace, it will require refining, and may also at the same time be colored, as fully described in Dr. Smith's paper, (*ante*, page 335.)

Manufacture of Axles and Piston Rods. By James Fenton, Low Moor, York, Civ. Eng., Patentee, Dec. 16, 1854.*

The invention consists in a mode of manufacturing axles, piston rods, and shafts, girders, and other like articles, by rolling up or coiling a plate of iron of any required thickness and size into a compact roll or coil, next bring it to a welding heat in a suitable furnace, and then drawing it to the required shape under a hammer, or by passing it when at a welding heat through a pair of rolls. The welding may be carried completely through or only partially, say half, through the mass; if the latter, a compound axle or other article will thus be formed, neither solid nor hollow, which it will be nearly impossible to break.

The manner in which the invention is performed is as follows:

A plate of iron is selected or prepared, of a suitable length, width, and thickness to form a compact roll or coil, containing sufficient metal for the production of the intended axle or other article. The thickness, and consequently the other dimensions of the plate, will depend upon the quality of the iron employed. This plate is heated to a red heat (when needful), and two or more workmen, with tongs or pinchers, turn up one of the edges; hammermen then bend down this turned-up edge on to the side of the plate, so as to form the commencement of a roll or coil; after which the operation is continued in the same manner until the whole of the plate has been rolled up, after which it may be passed through a pair of rolls, if considered necessary. A compact roll or coil of metal being thus produced, it is heated to the welding heat in an air or other suitable furnace, and then welded and drawn down under a

* From the Civil Engineer and Architect's Journal, Sept., 1855.

hammer to the form of the axle or other article required to be manufactured. The welding and shaping of the axle or other article may also be performed by passing the roll or coil of metal when at the welding heat between a pair of rollers, having sets of grooves of gradually decreasing diameter, in the manner commonly practised when rolling bars and rods of iron ; or the roll or coil may be submitted first to a hammering process, and then passed between grooved rollers until it is reduced to the required shape. The plate of iron employed for forming a coil or roll which is to be manufactured into an axle or other like article may be a compound one, that is, it may be composed of iron of different qualities, and in this case the plate should be so rolled up or coiled as to bring the iron of superior quality at the outer part or surface of the roll or coil. Two or more different qualities of iron may thus be combined in the same axle or other like article. In some cases also a small solid or hollow core o centre may be employed, and the plate of iron may be rolled up or coiled around this core until a mass has been produced of sufficient size for the production of the intended axle or other like article ; the process of manufacture is then concluded as above directed. Although in the foregoing description only hand labor is mentioned as the means of rolling up or coiling the plates of iron into a compact roll or coil, in some cases machinery suitably arranged for the purpose may be also made use of.

Claim.—The mode of manufacturing axles, piston rods, and shafts, girders, and other like articles, by rolling up or coiling a plate of iron into a compact roll or coil, next bringing this roll or coil to a welding heat, and then drawing it to the required shape under a hammer, or by passing it between rollers, or by a combination of hammering and rolling processes.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 15, 1855.

John C. Cresson, President, in the chair.

John F. Frazer, Treasurer.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of October.

The Board of Managers and Standing Committees reported their minutes.

Resignations of membership in the Institute by 15 gentlemen were read and accepted.

The candidates for membership in the Institute, (11,) were proposed, and the candidates proposed at the last meeting, (12,) were duly elected.

Dr. Rand exhibited Baker and Desilver's gas burner. It consists of two or more fish-tail jets placed at an angle, so that the flames may unite.

BIBLIOGRAPHICAL NOTICES.

Axonometrical Projections of the most important Geometrical Surfaces. By FERDINAND ENGEL.

A series of very excellent geometrical drawings, intended, however, we imagine, rather as a descriptive catalogue of the corresponding models than for any great independent usefulness. We feel sure, at least, that if there be any student who cannot form in his own mind, without reference to outward figure, a picture of the wave-surface of a light passing through a doubly refracting medium, he will be much more likely to be led astray than to be assisted by the drawing or model, very beautiful although they are, which are here given. For students of descriptive geometry, however, these figures will furnish valuable examples to copy from, as they are well conceived and executed, and comprise some of the most difficult figures for practice.

Explanations and Sailing Directions to accompany the Wind and Current Charts. By M. F. MAURY, LL. D., Lieut. U. S. Navy. 7th Edition, Philadelphia: E. C. & J. Biddle, 1855.

Lieut. Maury has the merit of originating an entirely new field of usefulness in determining the lines of shortest passage across the oceans, by careful collection of ships' logs, and consequent determination of prevailing winds and currents. The earnestness with which a multitude of navigators, both here and abroad, have entered into his scheme, is sufficient proof of the merit of the plan and the credit due to its suggestor. If, in connexion with this system or in any other way, Lieut. Maury can induce our seafaring men, who are, from education and necessity, acute and accurate observers of phenomena, to study the laws which govern these facts, and endeavor to account for them rationally and generally, he will have accomplished a still more important work. The work before us appears to be a highly meritorious effort in this direction, and we hope it will be found to excite the interest of those more directly concerned with the subject of which it treats, and induce them to pursue the subject still farther. While, however, we speak of this production of Lieut. Maury with all the respect which it deserves, we hope for the credit of his department and the title which he bears, that he will, in the eighth edition, (which, we hope, will soon be called for,) review carefully his Physical Geography. A more profound study of what is known on this subject will lead him to considerable changes in his treatise, and to not less considerable improvement in its value.

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